

Sustainable prosperity through innovation

Expert Panel report on transforming Alberta's innovation system



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In September 2013, the Government of Alberta, represented through the Ministry of Enterprise and Advanced Education, convened an Expert Panel¹ along with experts from University Ventures International (UVI) to deliberate the opportunities, challenges, and design and implementation options for an Alberta Institute for applied research and commercialization (henceforth, “the Institute”). The government’s purpose in establishing this Institute is to drive long-term economic growth and diversification in the province, enhance the effectiveness and efficiency of Alberta’s innovation ecosystem, and fill critical gaps in facilitation and brokerage between the public and the private sectors while recognizing the many strengths of the current system.

Many Expert Panel members are intimately familiar with Alberta and have been involved with research and innovation in the province over many years. Others were invited because of their international experience and expertise in devising and implementing innovation ecosystems around the globe. Daniel Roos, president of UVI and professor emeritus at the Massachusetts Institute of Technology, chaired the Expert Panel. Our deliberations, which took place in a series of meetings completed at the end of November 2013, were informed by broad consultation with stakeholders from government, academia, and multiple industry sectors.²

Once convened, the Expert Panel quickly realized that our mandate needed to be broadened to achieve the expected outcomes. We found strong indications that simply creating a new Institute, in the narrow sense of an institution funding and performing applied research and commercialization, would neither cut to the heart of Alberta’s transformation challenges nor yield the envisaged effect of an enhanced innovation ecosystem. Alberta’s problem is not a lack of organizations concerned with applied research and commercialization. To the contrary, the Alberta innovation ecosystem comprises a substantial number of funding, executing, and facilitating bodies – arguably more than needed for a province of Alberta’s size. Instead, the Expert Panel found a need for greater strategic alignment, coordination, and integration among the many organizations to increase the system’s overall *productivity* and *focus*. At present, parts of the system do well at optimizing their own activities according to their individual mandates but frequently at the expense of sub-optimizing the overall system, which prevents, in the words of one Expert Panel member, “the total impact of the system from being greater than the sum of the impact from each of the system’s parts.”

We believe that before any new elements are added to the system, a number of shortcomings at the system level must be addressed. Simply adding an institution

¹ See Appendix 1 for more information on the Expert Panel.

² See Appendix 2 for a list of the consultation meetings.

alone may exacerbate some of what holds back the productivity of the overall system today.

Throughout our study, the Expert Panel encountered remarkable enthusiasm and support for the Institute initiative, but also considerable uncertainty regarding its implications, in part owing to missed communication opportunities and recent provincial budget cuts. The Expert Panel took these concerns very seriously. We emphasize that we understand our mandate to be the deliberation of an initiative in *economic development* - not research or higher education *per se*. Our recommendations aim to ensure

Alberta's economic, social, and environmental prosperity for decades to come, in which we believe research, innovation, and commercialization must play a central role. None of our recommendations should be read to imply diverting resources from basic research and education or otherwise be to the detriment of post-secondary institutions.

We are confident that our recommendations will pave the way for a strong and robust innovation economy in the province. We are honored to have had this opportunity to provide input, and look forward to Alberta's future success.

Expert Panel Members

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Key recommendations

Vision

Make innovation the explicit centrepiece of Alberta's economic strategy for the future.

Recommendation #1

Establish two new bodies to guide, oversee, and manage innovation in Alberta: a top-level government Advisory Body and a central innovation portfolio Management Body.

Recommendation #2

Embark on a clearly defined implementation process of 6 to 12 months to achieve the necessary planning and lay the groundwork for the new system. Establish an Interim Board to oversee the transition, supported by a transition management team.

Recommendation #3

Focus the innovation system on a long-term strategic vision to strengthen coherence and an overall sense of direction. Articulate "grand challenges" and flagship initiatives to facilitate targeted investment.

Recommendation #4

Ensure that all key players in the innovation system work closely together and support the needs of the private sector. Develop a nimble, responsive, and accountable structure around the central Management Body that serves as facilitator, connector, honest broker, and change agent.

Recommendation #5

Apply a wide range of policy measures to foster innovation, recognizing that innovation policy has a much broader purview than science policy.

Recommendation #6

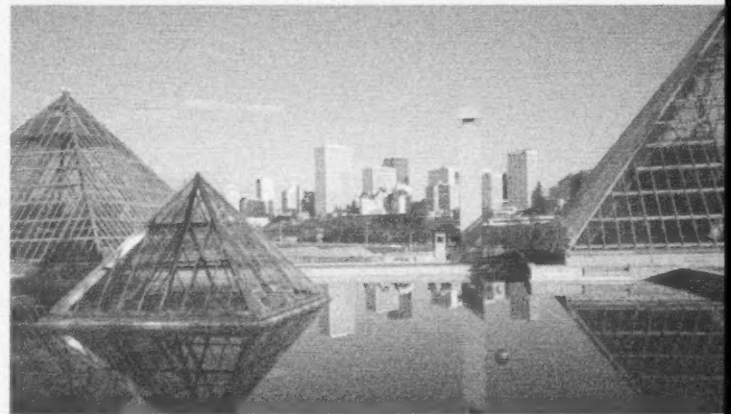
Balance top-down directives with bottom-up initiatives. Work towards launching one or more initiatives that help build critical mass from the ground up and enroll key actors in developing a long-term strategy.

Alberta today is in a comfortable position, enjoying economic strength and a high standard of living thanks to its abundant natural resources. However, strong global competition in the province's critical energy sector along with commodity boom-and-bust cycles pose undeniable long-term risks and challenges. At the same time, the province faces increasing environmental challenges. Previous efforts to develop a regional innovation-based economy have yielded less than the desired results. Albertans have come to share a sense of urgency that these issues must be addressed now to ensure sustainable prosperity for the future of the province.

This is the backdrop to Alberta's 2013 government announcement of an *Alberta Institute for Applied Research and Commercialization*, conceived as a comprehensive vehicle to drive long-term economic growth and diversification in the province, address missing links between industry and the public sector (including government organizations, Campus Alberta institutions, and innovation service providers), and raise the productivity and effectiveness of the province's innovation system. This report assesses the opportunities and challenges associated with such an Institute initiative. It is the product of broad stakeholder consultation with representatives of government, academia, and multiple industry sectors, along with a series of meetings by an international Expert Panel and a review of provincial and international innovation strategies.

Several facts became very clear in the consultation process. The Expert Panel notes the great enthusiasm

and support among stakeholders in government, academia, and industry for both an Institute and the broader vision it represents. Stakeholders see an urgent need and tremendous opportunity to emphasize the role of technology and innovation in Alberta's future, and better connect and align the many players that can contribute to that innovation.



At the same time, we determined it would be a mistake to take a narrow view regarding what an Institute initiative can achieve for Alberta's economic development. The Institute is meant to spur nothing less than an economic *transformation* that will ensure prosperity for future generations. However, for an Institute to be truly transformative, it must take into account the entire innovation ecosystem, which already includes many organizations committed to innovation in Alberta. It must be based on a clear vision for technology and innovation in the province, and be empowered with system-wide leadership to implement this vision through strategic flagship initiatives and activities across sectors. It must derive its mission and authority from government priorities

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at the highest level, and be able to line up behind them the wealth of strong existing organizations and programs in the province. Many stakeholders today lament clearly visible fragmentation and duplication and a lack of clear direction for the system as a whole. A new Institute that does not intervene systemically may simply replicate, or even aggravate, the causes of the current system's underperformance.

We believe the way forward is for Alberta to embrace a vision that makes innovation the explicit centrepiece of the province's economic strategy for the future, with a province-wide commitment to do what is necessary to realize that vision. Innovation is the key to sustainable economic growth and societal prosperity. To unlock Alberta's innovation potential, however, it is critical to realize that innovation policy is much broader than science policy. It is concerned not only with research and its institutions, but must provide a comprehensive foundation for local firms and industry sectors to achieve competitive advantage. It must further consider social, economic, political, legal, and organizational matters related to how innovation is created and takes hold. As such, it concerns the whole of government and requires a well-aligned innovation system that can act effectively and comprehensively.

Our recommendations in this report flow from, and provide the means to achieve, this overarching vision of putting innovation at the centre of Alberta's economic development agenda. Our principal recommendation, **Recommendation #1**, is to create two critical new entities required to provide the necessary strategic direction and management of Alberta's innovation ecosystem:

- A central innovation portfolio Management Body to manage independently all provincial investments and programs in research, development, and innovation, and provide comprehensive system-wide coordination and alignment with the province's innovation priorities. At a minimum, the Management Body should consolidate the four Alberta Innovates corporations and the Climate Change and Emissions Management Corporation (CCEMC) into a single entity; however it could potentially include many other entities from throughout the system. As a central vehicle to drive innovation in the province, the Management Body will truly transform and enhance the entire ecosystem. There is unanimity among the Expert Panel members, based on the consultation feedback we received and the international models we studied, that this is by far the most appropriate and auspicious step for Alberta to take towards economic diversification.
- A top-level government Advisory Body, chaired by the Premier and with cross-ministerial and non-governmental participation from key industry, Campus Alberta, and government stakeholders, that advises the Premier and the Cabinet on innovation policies, strategy, and initiatives. The Advisory Body will focus on long-term needs and trends in the province and elsewhere and set strategic priorities and directions for innovation. It is the essential complement to the Management Body, the critical missing link between government and the innovation ecosystem, and the instrument through which the government will take ownership of the innovation vision.

Recommendation #2 outlines an implementation strategy to develop the Management and Advisory bodies through a clearly defined process lasting 6 to 12 months. Alberta cannot afford to wait for legislative authority to implement the two new bodies, so we

recommend establishing interim bodies that will allow the transformational work to commence immediately and lay the groundwork for the new system while legislation is considered. An Interim Board will lead and oversee the transition process, supported by a full-time transition management team to prepare and execute the transition, define the parameters of the restructuring process, and develop the administrative processes for the next phase.

Recommendations 3-6 address specific urgent needs in the innovation system, and are aimed at facilitating a broad innovation-oriented culture shift in the province.

Recommendation #3 is to focus the innovation system on a long-term strategic vision to strengthen coherence and an overall sense of direction. This requires articulating the province's long-term strategic goals and how they can be addressed and operationalized through concrete initiatives in the context of the proposed restructuring, including strengthening mission-oriented research and articulating "grand challenges" for the province that will catalyze strategic long-term investment.

Recommendation #4 is to provide firms with the strong support they require as the central agents of innovation and economic value creation, and as the primary clients of the province's innovation ecosystem. The Management Body and the innovation ecosystem more broadly must help address the challenges faced by all levels of the private sector, help existing firms improve and expand, and attract multinationals that today have little or no presence in the province. The innovation ecosystem should spur creation of promising startups.

Likewise, the Management Body will enable Campus Alberta to make a greater contribution to the

province's economic and social prosperity. Strong institutions of higher education and research are essential to all the world's successful innovation ecosystems. A healthy and complete innovation system includes diverse and excellent basic research alongside applied research (both mission- and commercially oriented), development, and commercialization. We emphasize the importance of competitive funding at the provincial level, and stability and security in the long-term planning for Campus Alberta institutions.

The Management Body will be key to ensuring that innovation players (private sector, Campus Alberta, government, and innovation service providers) work closely together. It will provide the province with a nimble, responsive, and accountable structure that serves as a connector, facilitator, and honest broker among the various stakeholders. The Recommendation further addresses ways to establish a single access point to the innovation ecosystem. The Management Body will be the change agent for the entire system.

Recommendation #5 is to identify and implement the broader policies required to foster innovation that go markedly beyond science policy. These include competitiveness policy, a firm- and investor-oriented fiscal policy, human resource policy, and broader regulatory interventions in setting health, environmental, and technical standards. These also include consideration of national and international links the province must embrace as part of its future innovation trajectory.

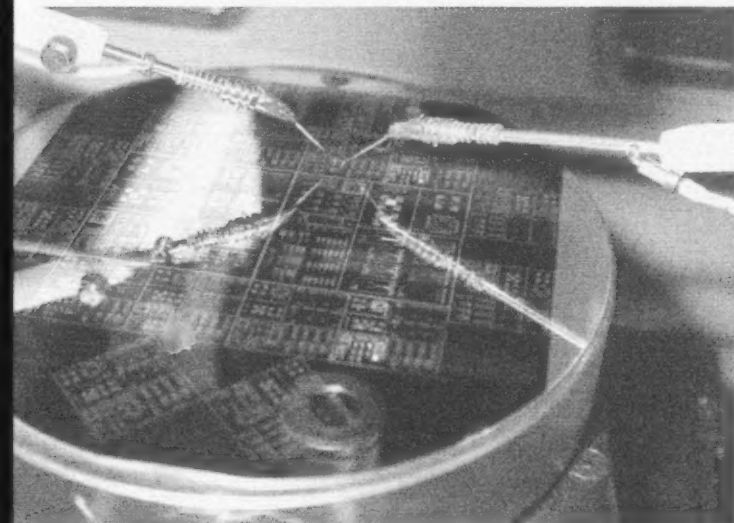
Finally, **Recommendation #6** complements the top-down restructuring efforts by proposing initiatives to help build critical mass and excellence from the ground up and contribute to articulating a long-term strategy and key "grand challenges" for the province.

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These six recommendations are designed to add coherence and improve alignment in Alberta's innovation ecosystem in the near term as well as correct specific weaknesses that exist today. They complement current efforts with broader activities to be launched over the next year. Implementing these recommendations will begin a transformative process that will drive decades of positive development in the province. They establish the foundation upon which Alberta will, over time, assert its leadership in selected industries through technological innovation in the province's already strong industrial sectors, and blaze trails in new technology areas where critical mass has not yet been achieved. Implementing these recommendations will result in more industry-driven research, better innovation outcomes, and stronger

links between firms, Campus Alberta institutions, and government organizations. Most important, they will achieve for Alberta what it needs first and foremost: a strong, productive, and accessible innovation ecosystem so the province can assume its rightful position, front and centre, on the world's innovation stage.

What we propose in this report has a time horizon of thirty years or more, paving the way for sustainable prosperity in the province through innovation. But the time to stake Alberta's bold claim is now, when both the need and the consensus are so great.



Why innovation? Why now?

Alberta's history has been one of success. At the beginning of the 21st century, the province is doing extremely well, enjoying admirable economic strength, a high standard of living, high per-capita income, strong and democratic institutions, a broad range of successful small- and medium-size companies, and positive net immigration. Over the past two decades, Alberta's economy has led Canada in average annual economic growth and the province remains one of the nation's most important economic growth engines. The energy sector represents Alberta's driving economic force and is complemented by other sectors such as petrochemicals, finance and real estate, agriculture, forest products, industrial machinery, healthcare, and information technology.

At the same time, Alberta's successes have created a number of pressing challenges. Strong reliance on the energy sector for export revenue has made the province vulnerable to economic shocks from boom-and-bust cycles. The province's main source of export revenue - crude oil increasingly produced from oil sands - is costly to extract and is threatened by energy alternatives such as shale oil, produced by competitors using the same technologies that have made shale gas economical. Alberta's primary energy export market, the United States, has made significant strides towards greater energy independence, putting Alberta's energy export revenues increasingly at risk.

While Alberta's natural resource sector has flourished, other sectors in the province have found it difficult to gain traction and attention, achieve critical mass, and attract the best talent. In addition, Alberta's prosperity is closely linked to questions of environmental sustainability, which makes the province a growing target of global environmental criticism.³

“The world is changing. It works differently than it did even a decade ago. We cannot afford to shut our eyes to this transformation. Neither can we let today's prosperity make us complacent.”

Emerson Report, 2011

Paradoxically, Albertans have come to share a sense of urgency that these issues must be addressed now to ensure future prosperity in the province while, at the same time, the decades of wealth creation and associated high standards of living have undermined the necessary sense of urgency for economic diversification. This has made it difficult to bring about fundamental change. Some have even cautioned against the prospect of an Alberta “resource curse.”⁴

Without a doubt, Alberta has the capacity to address these pressing challenges head on. It has greater

³ See, e.g., “Climate Science: A line in the sands,” *Nature*, August 2013, and “Greenhouse Goo,” *Scientific American*, July 2013.

⁴ See, e.g., Carter, Angela V. 2008. “Escaping the Resource Curse.” *Canadian Journal of Political Science* 41 (01): 215-217; Beine, Michel, Charles S. Bos, and Serge Coulombe. 2012. “Does the Canadian Economy Suffer from Dutch Disease?” *Resource and Energy Economics* 34 (4): 468-492.

Why innovation? Why now?

financial strength, higher-quality human resources, and stronger institutions than many other regions around the globe that are working proactively to secure their economic futures.³ A deeply entrepreneurial province, it is a model for individual and collective success. Provincial political leadership has demonstrated repeatedly the will to move forward and has launched a number of initiatives and restructuring processes that are cornerstones of a long-term economic development agenda. In particular, the government has taken commendable steps over the past half-decade to invest in science and technology as essential ingredients of socioeconomic advancement, modernize and harmonize the province's institutions of higher education, and enhance the current innovation system.

These efforts, though, have not yet come to full fruition. Stakeholders inside and outside the government note that sizeable investments made in the system in recent years are not yielding the expected returns. Some of the most important ambitions expressed through the *Alberta Research and Innovation Act* - designed to promote the development

and growth of new and existing research and technology-based industries, and increase the strategic use of resources to meet the innovation priorities of the province - have only partially been met. To date, the province's economy remains heavily dependent on commodity resources. Innovation - the translation of knowledge into commercial value - is weak in Alberta according to measures of business expenditure on R&D, number of patents received, productivity growth, and venture capital investment. Industries outside the energy sector such as forestry and agriculture, while strong, have historically been complacent about providing low-value-added commodities to the world market, foregoing additional value that could be created by moving up the value chain. Other sectors have remained underdeveloped due to the aforementioned crowding out by the energy industries, lack of market pull, and the absence of multinational corporations and their global supply chain networks. Campus Alberta institutions are recognized suppliers of a strong workforce, particularly first-rate science and engineering talent for the province, and have gained a reputation for excellent research in select areas; yet, they are only beginning to realize their potential as entrepreneurial and innovative institutions, active drivers of a regional knowledge-based economy, and advocates for an entrepreneurial culture. All this raises questions regarding the sustainability of the current Albertan mode of wealth creation for the future.

Sustainable prosperity for the province requires that Alberta moves forward and *transforms*. The province must take the necessary steps that will enable it to assume its rightful place as a leader among the world's innovation-based economies.

³ See Appendix 3 for a summary of Alberta's strengths, weaknesses, opportunities, and challenges. For a recent discussion of the transformation potential of select resource-driven economies (including Canada), see Dobbs, Richard et al. 2013. "Reverse the curse: Maximizing the potential of resource-driven economies," The McKinsey Global Institute.

A vision for science, technology, and innovation in Alberta

What Alberta needs, then, is a clear vision for a sustainable and prosperous economy. That vision must acknowledge the inevitable limits of today's resource economy and lay the groundwork for wealth creation and a high quality of life in the province for decades to come. It must not stifle existing strengths, but turn them into pathways for sustainable prosperity based not on comparative advantage, but on innovation and *competitive* advantage. It must shift the centre of gravity to a 21st-century knowledge economy by creating a strong, coherent, and effective innovation ecosystem supported by strong regulation and policies. And it must focus on the private sector as the primary source of wealth creation. Above all, Alberta must acknowledge that realizing such a bold economic vision requires a decisive, concerted effort of government leaders to align all stakeholders in pursuit of strategic goals. Cosmetic changes to business as usual are not the answer.

We believe the way forward is for Alberta to embrace a vision that makes innovation the explicit centrepiece of the province's economic strategy for the future, with a province-wide commitment to do what is necessary now to realize that vision. Innovation is, and must be recognized as, the engine of sustainable prosperity in the province, and the key to the Premier's triple bottom line of securing the province's economic future through a broadened economic base, advancing world-leading resource stewardship and

environmental management, and supporting healthy and resilient communities.⁶

For this economic transformation to take place, however, it is crucial to realize that innovation policy is different than science policy. Sound innovation policy is much broader in scope than funding scientific research and technology development. As such, it concerns the whole of government and requires a well-aligned innovation system that can act effectively and in a comprehensive manner. Alberta's efforts must go markedly beyond what has been done in the past (see Box 1). The province must accomplish a **culture shift** at multiple levels:

- At the **system level**, articulate and implement a clear, coherent strategy to align, broadly and with a solid implementation plan, all provincial activities - from oil extraction to educational initiatives to tax Policy - with the vision of enabling sustainable prosperity through innovation. Transition from the prevailing "technology-push" approach that views innovation as primarily the result of research supply to a more market-oriented approach that views innovation as the result of addressing industry needs, developing new markets, and pursuing mission-oriented research (along the lines of the famous Alberta Oil Sands Technology and Research Authority, AOSTRA).
- At the **institutional level**, incentivise organizations to align decisively with provincial goals. Combine strengths where needed (e.g., among universities

⁶ See, e.g., 2013-16 Government of Alberta Strategic Plan.

Why innovation? Why now?

and government agencies), adjust metrics and mandates to include measures of collective success as well as individual institution success, and overcome boundaries between industrial, academic, and governmental activities and silos among disciplines and sectors. At a time when societal challenges, policy agendas, scientific questions, and technological solutions are so complex and multidimensional, only a cooperative approach will work.

- At the **program level**, pursue initiatives that create alignment among organizations at all stages of the innovation lifecycle. Incentivise investment in Albertan businesses and inspire individuals and organizations to locate in the province. Return to flagship initiatives of the calibre of an AOSTRA 2.0 that tackle provincial challenges head-on and can spearhead the formation of new critical sectors. AOSTRA remains the common reference point among Albertans for unmatched impact through a targeted, government-led strategy. It was a “made-in-Alberta” solution for a uniquely Albertan opportunity, and is widely credited for today’s provincial economic success. Yet, both the province and the world have changed dramatically since AOSTRA’s 1974 inception, and there has been no similar initiative in Alberta since that time. Without question, this will require substantial new investments.
- At the **individual level**, harness the demonstrated drive of Albertans to innovate. Educate, attract, and retain the brightest talent from the province and around the globe, and enable these individuals to excel in areas pertinent to Alberta’s strategic goals. The province should provide new opportunities and

tout the individual successes of entrepreneurs as a way to inspire and lead a culture shift. People are essential to innovation, and Alberta’s diverse population in communities across the province will power its transformation and prosperity.

These are the opportunities and requirements for a fundamental economic transformation to ensure sustainable prosperity in Alberta.

How might this transformation and underlying culture shift be achieved? That question is at the heart of our report. To answer it, the Expert Panel consulted with stakeholders across the province and

“Investing in Alberta’s research and innovation system assures a focus on economic resiliency and environmental responsibility driven by Alberta’s engine of innovation – people.”

Alberta Research and Innovation Plan, 2012

conducted a broad review of policy documents and international best practices. These provided guidance on the initiatives needed to advance the province’s desire for long-term economic growth and prosperity. In particular, we explored how an Institute could be used as a change agent and become a critical vehicle for transformation.⁷

⁷ This institutional strategy was first proposed in May 2011 by the Premier’s Council for Economic Strategy in its report “Shaping Alberta’s Future” (also known as the “Emerson Report”) as part of a broader set of recommendations. See Appendix 4 for a summary of previous reports on innovation in Alberta and Canada.

Box 1: Innovation Policy is different than Science Policy

Historically, innovation policy and science policy have been thought of as essentially the same. This conflation was based on the assumption that the innovation process is linear: high-quality research fills a pipeline with bright ideas; applied research and technological development happens; the results are picked up and commercialized by industry.

Today, this view is commonly rejected. Science policy and innovation policy are different and they benefit societies in unique ways. Put simply, science policy is aimed at harnessing the results of scientific endeavours to society's advantage by creating and managing research capacity. Innovation policy, as defined by the European Commission's Directorate-General for Enterprise and Industry, "is about helping companies to perform better and contributing to wider social objectives such as growth, jobs and sustainability."

Sound innovation policy must go beyond ensuring world-class research to address regional competitiveness, trade, investment, taxation, education, labour and immigration, and broader issues such as health and environmental standards. It is essentially holistic in its approach, aiming at the seamless functioning of a complex system. When governments overemphasize science policy at the expense of other aspects of innovation policy, they may in fact inhibit innovation – symptoms of which can be seen in many regions strong in science but struggling to close the innovation gap, including Canada and Alberta. An imbalance between innovation policy and science policy may result in spending inefficiencies, missed economic opportunities, and even the loss of the brightest entrepreneurs, who seek their fortunes elsewhere.

The Expert Panel's vision for Alberta is thus based on a simple, powerful insight: Continuing to fund scientific research and technology development without addressing innovation holistically cannot, and will not, create a diversified, sustainable economy. Alberta needs a province-wide commitment to putting innovation at the centre of economic development, not keeping it at the receiving end as an output of science policy. This core message from our study builds on important insights from other recent reports on innovation in Canada:

- The 2011 report *Innovation Canada: A Call to Action* (the "Jenkins Report") argues for a "whole-of-government" approach for innovation in Canada: "the responsibility to foster innovation cuts across many functions of government and requires a system-wide perspective" [with a] "mandate to put innovation at the centre of the government's economic strategy and to engage the provinces in a dialogue on innovation to improve coordination and impact."
- The 2013 Council of Canadian Academies' *Paradox Lost* report analyses Canada's weakness in business innovation despite undeniable research strengths. This paradox "is resolved once it is recognized that ... most innovation does not work according to a 'linear' model ... [and that] business strategy in Canada is powerfully influenced by many factors besides those that motivate innovation." This structural condition accounts for many of the issues that continue to confound the innovation policy dialogue in Canada, such as "the particular difficulty of connecting university research with business. These are demand-side problems for which supply-side solutions continue to be proposed."

Key messages from the study

A major (and surprising) outcome of our study is the strong consensus we found among stakeholders with regard to what the province needs - and does not need - to drive innovation and economic development. This allowed us to converge quickly on a few central messages (summarized below) and probe these messages in more depth.

- **Enthusiasm and support for the Institute initiative is considerable.** Across the board, the Expert Panel found tremendous support for the Institute and the broader transformation it represents. Stakeholders from widely varying institutions and sectors, with very different backgrounds, affiliations, and motivations, agree that a greater focus on research and knowledge-intensive industries, with a view towards economic

diversification and long-term competitive advantage, is critically important, and that the timing is right. Many have been hoping for just this type of initiative for years. UVI's preliminary assessment in December 2012 spurred considerable discussion (and, in some cases, immense expectations) in the province about the Institute, and several organizations even began moving forward with their own visions and proposals.

- **Make sure you're solving the right problem: the lack of a systemic perspective.** Stakeholders have different opinions regarding the specific role the Institute should play and the problems it should address. Many pointed to examples of successful institutions or bodies in the province that fulfill various funding, connecting, implementation, or translational functions for

applied research and innovation - though there is much less clarity about how these entities connect and their broader missions. In particular, stakeholders cite a lack of oversight and cohesion within the current system. The core problem today is that the *system* has not delivered the desired degree of economic diversification and innovation-driven growth. This suggests that a systemic solution, rather than a purely institutional solution, is the most appropriate first step.

- **Before adding "yet another institution," there must be a coherent vision and strategy for meaningful innovation in the province, supported by a central Management Body that can effectively align the system behind such a vision.** To achieve its goals of innovation-based growth, the province must certainly invest more in applied research, development, and innovation in the province. Significant resources will be required to transform the economy and effect the necessary culture shift. However, much can be gained from improving the overall alignment and strategic focus within the existing ecosystem. The problem is not a *lack* of organizations concerned with applied research and commercialization in the province. Rather, as many stakeholders assert, Alberta has a "cluttered" system. There are inefficiencies that result from a lack of clarity regarding roles and responsibilities. Duplication of effort is commonplace. Funds are dispersed non-strategically, often at a sub-critical level. Competition for resources, mission creep, lack of strategy and coordination, and imperfect knowledge about what organizations are out there and what they are doing all contribute to the problem. Stakeholders crave strategic direction and



Key messages from the study

guidance in the form of a clear innovation plan to tackle a long-term vision. They are looking to the government for leadership and a new “narrative” for Alberta that links science, technology, and innovation to sustainable economic development and social prosperity. In particular, they feel the province must tackle its challenges through strategic long-term programs linked to provincial priorities, such as a potential follow-up to AOSTRA. Stakeholders bluntly reject the idea of fixing the system by “simply adding yet another institution” before knowing where the system as a whole is headed. They are also wary of short-sighted fixes to more deeply rooted structural problems.

● **Recognize previous barriers to diversification.**

Stakeholders articulated several reasons for why efforts to improve the innovation system have had only limited success. Among those mentioned most frequently:

- The transformation process that began in 2008-09 and led to the 2010 *Alberta Research and Innovation Act*⁸ has stalled in achieving some of its key objectives. For example, the *Alberta Research and Innovation Committee*, established by legislation to advise the Minister of Enterprise and Advanced Education on the roles and responsibilities of research and innovation corporations as well as the coordination and prioritization of activities and initiatives, has met irregularly and has had limited success. The *Alberta Research and Innovation Authority* (ARIA), established with a strong international membership to provide strategic advice and recommendations to the Minister, has been

underutilized. Stakeholders note consistently that investments made in the system as a result of the restructuring in 2010 have not yielded the expected returns.

“One major challenge for Alberta has been our introspection. There is a tremendous need to widen our gaze.”

Online survey response from a private sector organization

- A clear vision and a strategy for innovation are lacking, which translates into a lack of clear focus areas and a tendency to spread resources too thin. Stakeholders lament the absence of strategic direction and guidance in the form of a long-term vision and clear operational plans for achieving stated objectives.
- There is too much of a “technology push” focus, rather than “market pull,” for innovation. We heard this in particular from industry stakeholders. At times, it seems as if the government is trying to perform and fund every possible function of an innovation system, rather than enabling *firms* to serve as the centre of gravity for innovative activities that engage Campus Alberta.
- There is a tendency to respond to all challenges with short-term “fixes.” A legacy of institutions and practices continues to live on in the current ecosystem, many parts of which contradict one another and international best practices, thus causing the system to underperform.

⁸ The 2010 Act was designed to promote and provide for the strategic and effective use of funding and other resources to meet the Alberta government's research and innovation priorities. This includes fostering the development and growth of new and existing industries and supporting a balanced, long-term program of research and innovation directed at discovering new knowledge and applying that knowledge to improve the quality of life of Albertans.

Key messages from the study

- The current system is too complex. There is no single source of information about the system and its distributed capabilities, and no “one-stop shop” for innovation service clients. Previous attempts to address this problem, such as the Alberta Innovates Connector launched in 2010, have not achieved their full potential. Certain essential connector and third-party honest broker functions are largely missing; these would facilitate links between Government of Alberta organizations, Campus Alberta institutions, the private sector, and innovation service providers.
- **Don't fix what isn't broken.** The current system is a major improvement over what existed prior to 2010. Many of its organizations are performing well according to their current mandates. The next step in Alberta's development must build on these achievements and strengths, not undo them. As stakeholders repeatedly warned, “Don't throw out the baby with the bathwater.”
- **Keep the dialogue going.** Stakeholders are legitimately concerned that a fully comprehensive view of the layout and quality of the current system is impossible in the time allotted for this study. A lack of trust in government initiatives

because of recent budget cuts, past unsatisfactory consultation processes, uncertainty about new government initiatives, and expectations (both positive and negative) about the Institute exacerbate this concern. For this initiative to succeed, process is at least as important as content. It should set new and much-needed standards for public participation, information dissemination, and solicitation of true consensus on proposals - all of which require that the dialogue continue.

We agree wholeheartedly with these messages from stakeholders. They are broadly consistent with our analysis as well as analyses in previous reviews of Alberta's innovation system and of the province's opportunities for economic development.



Recommendations for system redesign and implementation

As the key messages from stakeholders make clear, and as our study confirms, Alberta needs system-wide adjustments to drive a larger, system-wide transformation. This suggests presenting our recommendations in two sections, corresponding to two central questions:

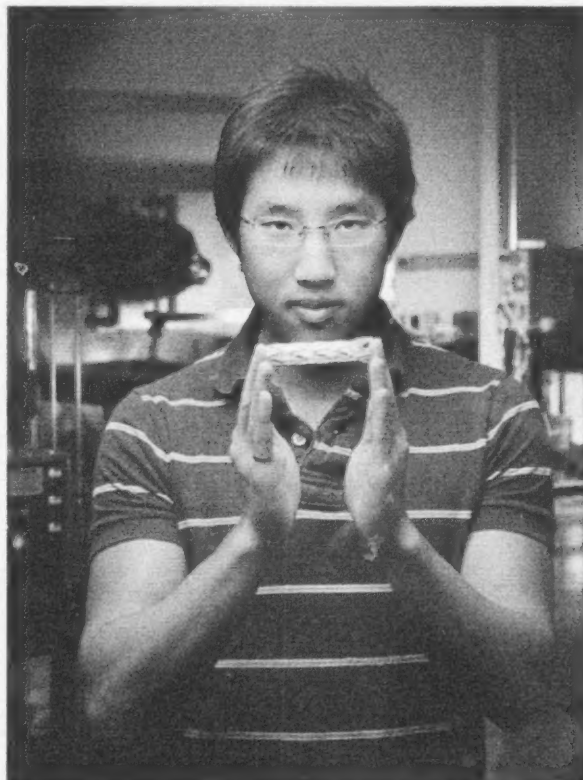
1. What is missing in Alberta's innovation system, and how do we get to a new structure from where we are today?

Recommendations 1 and 2 address a number of *system design* issues centred on creating an effective and more efficient innovation ecosystem that can lead Alberta to an innovation-based economy. In this section, we outline how the necessary transition should be implemented within a 6 to 12-month period, during which interim bodies will be established to oversee the process and lay the groundwork for longer-term transformation. The transition period will allow change to begin to unfold gradually and will provide opportunities for continued dialogue and deliberation.

2. Which specific items should be addressed, and what activities should take place, during the 6 to 12 month transition period?

Recommendations 3-6 address specific opportunities for improvement we observed and the actions required to begin a fundamental culture shift in the province. We make our recommendations in the form of *key considerations and guiding themes* for the system redesign, emphasizing that their transformative power will hinge upon the successful restructuring of the system.

We cannot overstate how critical it is that our recommendations unfold sequentially to achieve the desired system transformation and long-term viability of Alberta's innovation efforts. The broader systemic issues must be addressed first, followed immediately by the later set of activities. Failure to do so will leave in place a system already marked by incoherence and a lack of follow-through, and thus almost ensure its continued underperformance.



[Recommendation #1]

Establish two new bodies to guide, oversee, and manage innovation in Alberta: a top-level government Advisory Body and a central innovation portfolio Management Body.

A properly aligned and managed innovation system is key to success in economic transformation processes involving knowledge-intensive industries. The experiences of Finland, Singapore, Israel, Australia, Norway, Germany, South Korea, and other countries confirm the importance of a purposefully designed, coherent structure to bring together the many relevant actors (including individuals, institutions, and sub-sectors) required to unleash innovation and minimize bottlenecks and inefficiencies. The same applies at the regional level.⁹

Alberta's innovation landscape comprises many of the essential components of a functional regional innovation system, and the province has made considerable progress in recent years in terms of alignment and consolidation. However, the system remains relatively fragmented. Many entities are the result of historical mergers rather than purposeful design, and the system lacks several essential components. At times, this leads to unclear definitions of mission and scope (particularly in the case of the

Alberta Innovates corporations), as well as significant duplication of efforts. Public funding streams are generally difficult to trace throughout the system, making it difficult to assess overall system performance, and no one in the system has strategic oversight for building capacity, where synergies are located, and where the system is headed. This needs to be addressed decisively.

Much can be gained by studying how other jurisdictions have managed similar transition challenges.¹⁰ However, one must take care to choose benchmarks wisely. Every innovation system is unique in its specific scientific, social, political, and economic embedding, and simplistic generalizing of lessons and the transferability of models from elsewhere is problematic.¹¹ Cultural preferences, the existing institutional landscape, and historical experiences and visions are as important as macroeconomic factors such as labour, capital, and resource abundance. One country or region's strength may be another's bottleneck, as critical

⁹ See, e.g., Braczyk, Hans-Joachim, Philip Cooke, and Martin Heidenreich, ed. 2004. *Regional Innovation Systems: The Role of Governances in a Globalized World*. 2nd ed. Routledge. Cooke, Philip, and Olga Memedovic. 2003. "Strategies for Regional Innovation Systems: Learning Transfer and Applications." UNIDO Policy Papers. Vienna: United Nations Industrial Development Organization.

¹⁰ See Appendix 5 for more information on the innovation systems reviewed.

¹¹ See, e.g., Tödtling, Franz, and Michaela Tripl. 2005. "One Size Fits All? Towards a Differentiated Regional Innovation Policy Approach." *Research Policy* 34 (8), 1203-1213.

innovation functions may be served by different parts of different systems. Moreover, while many aspects of national innovation systems may apply to a province, differences in size, jurisdictional scope, and power to wield policies and resources may limit comparability. All these factors must be taken into account when looking at the transfer of international best practices.

Our analysis has been shaped by two common patterns we observed among jurisdictions similar to Alberta seeking to foster innovation. First, when developing or enhancing their innovation systems, many adopt a centralized and well-coordinated (top-down) approach to steer the transition. Often, this involves establishing an *overarching innovation council* that straddles ministries and sectors. The goal of these councils is, among other things, to achieve direct involvement of the top government leader (i.e., the president or prime minister) as council chair, which has in many instances propelled the innovation agenda forward considerably. Second, to ensure coherence of the new system and bundle resources around strategic goals, it is common to establish a central *body to manage the innovation portfolio*. Many jurisdictions have found it insufficient simply to add programs or new institutions, or implement new policies in support of bottom-up innovation initiatives, because the existing system first requires attention and central oversight to enable greater alignment and effectiveness. This manifests itself in management bodies that support close collaboration between industry, government, and academia and attract the type of industry investment in research and development that is a cornerstone of innovation.

We find that a proper innovation system for Alberta will require at least two new entities. This is confirmed by our review of transition strategies in select innovation systems similar to that of Alberta.

1. A top-level government Advisory Body, chaired by the Premier or Deputy Premier and with cross-ministerial and non-governmental participation from key innovation stakeholders, will advise the Premier and the Cabinet on innovation policies, strategy, and initiatives, help address provincial priorities, and regularly bring to the attention of the Cabinet the needs and concerns of stakeholders from across the province.

2. A central innovation portfolio Management Body, reporting to the Cabinet through the Minister for Enterprise and Advanced Education but operating independently at arm's length, will manage the entirety of Alberta's strategic investments in applied research, development, and innovation and oversee all such programs for the government, as well as provide greater coordination and alignment within the system to achieve the province's vision and transformation.

1. Top-level government Advisory Body: Innovation in Alberta needs highest-level, cross-departmental government attention and coordination to a much greater extent than at present. Innovation straddles sectors and government departments, and future economic prosperity should be the concern of the entire government as part of an integrated whole-of-government approach. It is essential that the Premier and/or Deputy Premier be involved in the innovation agenda, and government at the highest level have direct communication channels and means for continual exchange with key innovation stakeholders to keep abreast of major developments in the province and elsewhere.

Recommendation #1

- International experience illustrates the need for this level of government involvement and support to achieve a targeted and successful innovation system well aligned with government directions. Examples include the Singapore Research, Innovation and Enterprise Council (chaired by the Prime Minister), the South Korea National Science and Technology Council (co-chaired by the Prime Minister and an industry representative), the Finland Research Innovation Council (chaired by the Prime Minister), the Australia Prime Minister's Science, Engineering and Innovation Council (chaired by the Prime Minister), and the Innovation Dialogue of Germany.¹² Alberta's Advisory Body should have a similar level of commitment from the highest level of government. Each successive Premier or Deputy Premier should chair the Advisory Body, which could perhaps be co-chaired by an industry representative (as in Korea).
- The body must include representation from core government ministries, Campus Alberta, and key industry players (including finance) to achieve the necessary traction within the system. For example, Finland's Research and Innovation Council includes the Prime Minister (chair), seven Ministers (Finance, Culture, Defence, Health and Social Services, Environment, Interior, Public Administration and Local Government), six members from academia and science funding bodies (universities, Academy of Finland, TEKES), and four industry representatives (including one from the trade union federation).
- This Advisory Body could go by one of several names (see Box 2). In the context of the 2010 Alberta Research and Innovation Act, the Advisory Body would combine (but go beyond) the Cross-Government Portfolio Advisory Committee and the Alberta Research and Innovation Committee. It would be an innovation-centred counterpart to the successful Alberta Economic Development Authority (AEDA), which advises the Premier and Cabinet on economic development strategies and key economic issues.
- The Advisory Body's prime responsibilities will be to advise the Premier and Cabinet on national research and innovation policies and strategy to foster technology- and innovation-based economic growth and diversification, deliberate high-level innovation priorities and initiatives for the system, ensure the effectiveness of all executing bodies (particularly the Management Body discussed below) through appropriate accountability measures, stimulate and coordinate activities across government departments and relevant policy domains, realize important transversal links between parts of the system, and allow for continuous input and articulation of needs by stakeholders from the entire system on issues pertaining to innovation. It will be a touchstone and become a forum and anchor point for broader policy changes (see Recommendation #5), and continuous public dialogue and deliberation about Alberta's future.
- The Advisory Body should meet at least semi-annually and be supported by a secretariat with considerable in-house and international expertise on science, technology, and innovation policy issues. The secretariat will provide policy analysis and advice on strategic questions that arise. We believe this function could be fulfilled by an augmented version of the Alberta Research and Innovation Authority (ARIA) secretariat, which

¹² The Singapore Council's website describes the body as follows: "This high-level council underscores the political commitment and importance placed on the national R&D agenda" and provides the main pathway to "advise the Singapore Cabinet on national research and innovation policies and strategies to drive the transformation ... into a knowledge-based economy" (<http://www.nrf.gov.sg/about-nrf/governance>). See Appendix 5 for more information on the innovation systems reviewed.

would then report to the cross-departmental Advisory Body rather than to Alberta Enterprise and Advanced Education (EAE). Similarly, the members of the ARIA board might be retained to serve on the Advisory Body, as they would bring an international perspective.

2. A central innovation portfolio Management

Body: Alberta requires a single entity to oversee and manage strategically the province's innovation portfolio and associated funding streams. At the very least, this should include the budgets of the four Alberta Innovates corporations and the CCEMC, but potentially many more government funds associated with various organizations funnelled through several ministries. Without centralized oversight and management, it will be very difficult to achieve sufficient alignment and accountability, create critical mass in priority areas, and enact transformational change.

- Again, international experience shows that this level of concentration and high-level steering is necessary to create and manage a coherent and impactful innovation system. Organizations of similar scope operating in economies with a context comparable to that of Alberta include TEKES (Finland), the Technology Strategy Board (UK), Innovation Australia (Australia) and Callaghan Innovation (New Zealand).¹³
- This Management Body could go by a variety of names (see Box 2). Hosted by EAE and reporting to the Cabinet through the Minister of EAE, it will be by necessity an independent, arm's-length management organization operating under best business practices for accountability and with a province-oriented mandate and mission, both similar to that of the Alberta Investment Management Corporation (AIMCo).

- The Management Body's primary responsibilities will be to oversee, implement, and administer all of Alberta's activities in publicly sponsored applied research, development, and innovation. This includes defining programs to build technology areas aligned with the province's innovation strategy and building critical mass in these areas. It further includes operationalizing long-term technology and innovation initiatives in the province to tackle grand challenges. For example, if AOSTRA were to be established under the proposed system, it would be managed by the Management Body under the aegis of the Advisory Body. It is conceivable that several flagship initiatives could be defined by the AB and implemented by the Management Body, with multiple initiatives underway simultaneously.
- The Management Body will become the centrepiece of Alberta's enhanced innovation system and the standard-bearer of an economic transformation. It will integrate the current Alberta Innovates corporations, the CCEMC, and other government organizations to form the core of the new system and complete the stalled ecosystem restructuring process that began in 2010 (Recommendation #2). It will embody and give substance to Alberta's vision of economic development through innovation, and implement it through new flagship programs tied to the province's greatest challenges (Recommendation #3). It will reorient the current system around the needs of industry and Campus Alberta institutions, strengthen university-industry-government interaction through targeted initiatives, and serve innovation clients through a "one-stop shop" (Recommendation #4). It will become the home to many bottom-up initiatives focused on excellence and competitiveness (Recommendation #6).

¹³ See Appendix 5 for more information on the innovation systems reviewed.

Recommendation #1

- As with every defining initiative, competent leadership is key. Recruiting an outstanding CEO for the Management Body is of paramount importance, and that selection process should brook no compromise. The CEO should have international standing and the credentials to garner the respect and confidence of key stakeholders: Campus Alberta, the business community, the research community, investors, and the government.
- The Management Body and Advisory Body are complementary and equally crucial components of the same strategic move to enhance Alberta's innovation system and give it a proper, effective

structure. Through a direct link with highest-level government authorities by reporting directly to the Cabinet through the Minister of EAE, the Management Body will become the central pillar of the government's innovation strategy and be responsible for operationalizing the vision and strategy as deliberated and articulated by the Advisory Body. The Management Body should develop five-year tactical plans through which the province's innovation strategy is implemented.

Box 2: What's in a name? Some suggestions:

The Expert Panel has given some thought to the question of naming the Advisory Body and Management Body.

Most common in international practice is to call advisory bodies of the sort we recommend a *council* (e.g., Alberta Innovation Council, AIC) or *committee*. However, an important consideration is that the new body fit naturally within the existing landscape; the name it is given can help provincial stakeholders make intuitive sense of its function. For Alberta, the best choice might thus be *authority*, which would suggest some symmetry with the Alberta Economic Development Authority (AEDA), its counterpart in economic development. Acknowledging our recommendations that the current Alberta Research and Innovation Authority (ARIA) secretariat be elevated to become the secretariat of the new Advisory Body, a straightforward possibility would be to retain and expand the name ARIA to refer to the entire Advisory Body. This, of course, depends on the course decided for ARIA in the restructured system.

The central portfolio Management Body could be called a *corporation* (e.g., the Alberta Research and Innovation Corporation, ARICo). There are at least two compelling reasons for this choice. First, there are already corporations within Alberta Innovates that will form key components of the Management Body. Second, *corporation* will reflect the paragon of AIMCo as an arm's length Management Body with a provincial mandate. Other names in international usage include *board* and *agency*. Some countries have chosen short names such as Innovation Australia or have used the name of a seminal figure in the country's innovation history (such as New Zealand's Callaghan Innovation).

[Recommendation #2]

Embark on a clearly defined implementation process of 6 to 12 months to achieve the necessary planning and lay the groundwork for the new system. Establish an Interim Board to oversee the transition, supported by a transition management team.

Fundamental change in operating complex systems such as Alberta's growing knowledge economy does not happen overnight. New legislation needs to be written, some existing legislation will require amending, governance models and operation procedures must be reconfigured, budgets prepared, and human resources allocated in a well-sequenced manner. Rapid, disruptive change can carry a number of risks, including interrupting the financial lifeblood and continuity of important ongoing projects and programs. Another risk is that important structural components may be shifted or eliminated prematurely. We acknowledge that the present study has only begun to reveal and unravel the many intricate relationships among existing entities - but this initiative will not expose Alberta's innovation system to such risks.

Alberta cannot afford to defer beginning the transformation of its innovation system any longer. We therefore recommend an implementation strategy that commences immediately at the beginning of 2014 and takes the necessary steps to put in place the Advisory Body and Management Body within 6 to 12 months. This period will provide an opportunity for

finer-grained analysis and stakeholder input, and allow the transition to unfold in a measured and non-disruptive manner.

Establishing the Management Body and Advisory Body will require action by the Legislative Assembly. During the first half of 2014, the information needed to prepare legislation could be generated. The government typically introduces legislation in the spring and fall; enacting legislation to create the Management Body in Fall 2014 will allow the body to be constituted in time to participate in the 2015 budgeting cycle. Ideally, legislation to create the Advisory Body would also be introduced in Fall 2014, but no later than Spring 2015.

Given these constraints, we recommend establishing these two new bodies as part of the following sequence of events:

1. The first step in reconfiguring the system is to announce the intention to establish the new bodies.
2. The announcement should be followed immediately by appointment of an Interim Board, which will be constituted for the duration of the transition process. This board will oversee the

transition and the system's restructuring in its entirety, guided by the recommendations of this report. It will further oversee the budget for the transition and ensure that all units tasked with executing the transition meet their objectives.

We envision this board as a prototype for the Management Body to be established through legislation at the end of the transition period, both in terms of capabilities and responsibilities. It should report to the Cabinet through the Minister of EAE. It should be limited in size, with perhaps 6 to 8 outstanding individuals widely recognized for their expertise in the design, implementation, and management of innovation systems. Ideally, the board should broadly represent various stakeholder groups in innovation in the province (e.g. industry, academia, government, etc.); however, we consider knowledge about innovation systems more important than optimally balanced stakeholder representation. The board should be neutral and impartial to past and current budgetary and reorganization discourse in the province.¹⁴ Ideally, the board will comprise a mix of people from inside and outside the province; at a minimum, the board Chair should be from outside the province. The Interim Board will be dissolved after a maximum of 12 months with the establishment of the Management Body.

3. The Interim Board will be supported by a **full-time transition management team**, established at the same time, that will be responsible for planning and managing all details of the system's

transition. In particular, the transition management team will:

- a. Obtain a more complete picture of the system and the required Alberta Innovates system restructuring, including a continued consultation process and analysis of various organizational models from around the globe (identified in Appendix 5).
- b. Define the boundaries of the restructuring process;
- c. Develop a complete "system map" for the new system, including funding streams;
- d. Establish the administrative processes necessary in advance of launching the Advisory Body and Management Body, organise the Management Body, and advise the government on hiring a CEO for the Management Body;
- e. Advise the Cabinet on required legislation and strategic policy changes;
- f. Prepare new programs and initiatives that should commence with the launch of the full Management Body and Advisory Body (e.g., an AOSTRA 2.0-type flagship program); and
- g. Convey the value proposition of a restructured innovation system in the province and advocate for a culture shift toward innovation.

The transition team should commence its work immediately and complete the planning stage after a maximum of 6 months (i.e. by mid-2014) to ensure seamless integration into the legislative process.

For political neutrality, credibility, and to ensure a broad purview, we consider it essential that an outside group (i.e., one not affiliated with current

¹⁴ Alberta's innovation capacity is still shaped by the heritage of dozens of institutions that live on in the current system and continue to impose their former functionalities and political dynamics as parts of new bodies. For example, the Alberta Research Council, founded in 1921, preserves some of its functionality in its institutional home at Alberta Innovates Technology Futures, thus making it the only research-performing of the four sister corporations. As a result, there is confusion in industry regarding whether research opportunities should be addressed by Alberta Innovates Technology Futures (AITF) or Campus Alberta, which leads to competitive friction between the two and weakens both. Alberta needs the courage and clear leadership to break with old structures and mandates and redraw organizational boundaries where needed to maximize the efficiency of existing assets.

government organizations) lead the transition management team and in conceptual and managerial redrawing of the systems landscape. It is important that those who work on the transition process have no vested interest in existing institutional structures or functions. This external transition management team should have an adequate in-house government counterpart that provides the necessary expertise on Alberta legislation and coordinates and communicates across government departments. This in-house unit could be housed within the Ministry of EAE. The transition management team will dissolve with the establishment of the proposed bodies (after a maximum of 12 months).

4. While the Interim Board and the transition management team will work towards consolidating the Alberta Innovates corporations, the CCEMC, and possibly other bodies under the new Management Body, we recommend the current boards and management structures of the Alberta Innovates corporations and the CCEMC be left in place for the duration of the transition period to ensure that ongoing programs continue to function.
5. The statutory Management Body established after the transition period should consolidate a number of existing entities in Alberta's innovation system; the Interim Board, together with the transition management team, should make a clear determination of which bodies to bring under this umbrella. Fragmentation and confusion are central concerns that emerged in the Expert Panel's consultations, and coordinating all these functions under one administration is essential to

capturing the province's opportunities without waste and redundancy. To that end, the Interim Board should establish criteria for consolidation of an organization under the Management Body and then apply these criteria to develop a list of entities to be consolidated synergistically or at least to be centrally managed. (See Box 3 for some suggestions for criteria.)

“Take time to develop a strong governance model and clearly articulate outcomes of the Institute. Let these outcomes be very clear, focused and drive results.”

Online survey response from a national organization

6. Continuing the consultation process during the transition process is critical, both to gather additional information from actors in the current innovation system as well as to build trust and legitimacy for the initiative. The vision and activities proposed in this report involve, and will benefit, the entire province. They require using public resources, relate to questions of social licence and land use, and will affect all citizens in all regions of the province for decades to come. Ongoing public participation in the process is therefore vital. Past initiatives have gone off track in Alberta for lack of public support. Taking stakeholder engagement seriously implies flexibility with regard to strategy and outcomes.¹⁵

We recognize that the mandate and responsibility for defining and implementing the new system will rest

¹⁵ Germany provides several good examples of long-term public engagement in technological transitions or large-scale solicitation processes for the definition of future priority areas. For instance, the “BMBF Futur” process was a two-year, multi-stage endeavour involving hundreds of national and international academic and corporate scientists alongside lay participants to develop a focused and competitive research agenda for Germany in the 21st century.

Recommendation #2

Box 3: What falls under an innovation portfolio Management Body? Some suggestions:

Not including Campus Alberta-run organizations, a public sector organization should be considered for consolidation under the Management Body if it:

- a. Distributes or manages provincial funding for applied research, development, commercialization, or innovation-related activities;
- b. Manages relationships or information pertinent to the conduct or development of applied research, development, commercialization, or otherwise innovation-related activities among government, industry, and/or Campus Alberta institutions; and/or
- c. Manages sources of revenue directly or indirectly tied to Alberta's "grand challenges", particularly if they are or could be applied to innovation and economic diversification efforts.

The four Alberta Innovates Corporations and CCEMC are clear examples of organizations that should be subsumed under the Management Body. However, during the transition process, the current AI Corporations and Boards as well as CCEMC's leadership should continue to function and should be dissolved only when the legislation has been enacted and the new bodies are in place.

An important consideration is whether the Management Body should be in charge of R&D-performing organizations; that is, whether it should both manage entities that receive provincial government funding, directly or indirectly, to conduct applied research, product development, commercialization, or otherwise innovation-related activities, as well as manage entities that receive funding to provide scientific or technical services to industry or small businesses. It has been suggested repeatedly that the simultaneous pursuit of funding and performing functions (as exists currently, e.g., in the Alberta Innovates - Technology Futures corporation) may represent a conflict of interest. Moreover, several centres that perform applied research receive funding from multiple sources, including the federal government, and their integration into the Management Body may undermine their legal standing to do so. We recommend that the Interim Board consider in particular the following Alberta Innovates Centres: the Alberta Centre for Advanced Micro/Nano-enabled Products (ACAMP), the Alberta Glycomics Centre (Glycomics), Alberta Innovates Centre for Machine Learning (AICML), Imperial Oil - Alberta Innovates Centre for Oil Sands Innovation (COSI), Livestock Gentec (Gentec), Phytola, TECTERRA - Alberta Innovates Centre for Integrated Resource Management, and the Canadian Centre for Clean Coal/Carbon and Mineral Processing Technologies (C5MPT).

Recommendation #2

with the Interim Board and the transition management team. New insights will emerge from the continuing consultations, and some activities may yield unexpected results, so we recommend that the process should allow the Interim Board to implement the changes it considers appropriate. New plans to develop additional institutions, infrastructure, or large-scale applied research, development, and innovation programs within the province should be put on hold until the Interim Board and transition management team have completed their work. We acknowledge, of course, that several new initiatives are underway or will soon be launched; many involve partners outside the province, and there has already been considerable preparation. Given this reality, we underscore the need for these new initiatives to be taken into consideration in the proposed system restructuring effort. Conversely, these new initiatives should take care to ensure alignment with the recommendations of this report.

The end-state of the system transition laid out above is an enhanced innovation system centred on the Advisory Body and Management Body proposed in Recommendation #1, along with a variety of smaller and larger changes, partly outlined below, to support the new structure. This will elevate the incomplete transformation that began in 2010 to the next level and provide the strategic direction required for applied research, development, and innovation in Alberta in the coming decades.



Key considerations for the transition process

[Recommendation #3]

Focus the innovation system on a long-term strategic vision to strengthen coherence and an overall sense of direction. Articulate “grand challenges” and flagship initiatives to facilitate targeted investment.

Innovation systems tend to fare best when they have a clear sense of direction that provides intuitive benchmarks for measuring the degree to which activities are aligned with long-term objectives. This is exemplified by Singapore's shift from “intelligent island” to “biopolis” and the long-term socioeconomic visions published by Middle Eastern countries such as the United Arab Emirates and Qatar that have been the catalyst for billions of dollars of investment in research, infrastructure, human capital, and test-beds for establishing new industries. Moreover, these visions tend to be supported by strong and visible vehicles for implementation. For example, the Masdar Initiative in Abu Dhabi was conceived as the region's main vehicle for developing human capital, research capability, and an industrial base in advanced energy and sustainability. Similarly, flagship initiatives such as the recently launched Human Brain Project, funded by the European Commission at €1 billion over the next 10 years, or the Human Genome Project, funded by the U.S. National Institutes of Health at a level of \$2.7 billion over 13 years, are cases in point.

This section indicates how the overarching economic vision proposed in this report - to make innovation the explicit centrepiece of Alberta's economic development strategy for the future - can be leveraged to address a broad range of provincial priorities and operationalized in terms of specific programs and initiatives. With its high GDP per capita, Alberta's economy should already be firmly in an “innovation-driven” stage of economic development. Innovation is both the cornerstone of and vehicle for the government's ambitious triple bottom line of integrated economic, environmental, and social sustainability. This is precisely why transforming from a resource-dependent economy to an innovation-based economy is fundamental to Alberta's long-term prosperity (see Box 4).

From Alberta's broad economic vision, a range of specific activities must flow - some flagship initiatives, but also a broader suite of institutional missions, programs, policies, and practices across the province. The government should use the transition period to engage in (or continue) parallel deliberations

Box 4: Interrelated Visions and Missions for Alberta – some examples:

Beyond the transformative vision of centring Alberta's economy on innovation by creating an enhanced innovation ecosystem, there are several other interrelated visions for the province worth considering. Most are not new; many have been articulated before. Albertans with whom we spoke are, in fact, largely aware of these visions and how they relate to Alberta's major challenges.

At the highest level, the government has articulated its broad vision through a variety of documents and statements. The *2013-16 Government of Alberta Strategic Plan* emphasizes resource stewardship, economic security, and societal wellbeing as major objectives, expressed in the key targets of Effective Resource and Environmental Management, Broadened Economic Base, and Resilient, Healthy Communities. The 2011 Emerson Report highlighted five themes that guide the province's activities: realizing the full potential of Alberta's energy resources; broadening the economic base; preparing to prosper in a global economy; providing a strong platform to sustain economic growth; and investing in shaping the future. Overarching mission statements for the provincial ecosystem and Alberta's innovation agenda consistent with these themes include:

- Become a centre of innovation and best practices around responsible natural resource management.
- "Energize the world" while ensuring sustained domestic prosperity by becoming a recognized global supplier of petrochemicals, advanced energy, and food for a growing world population.

On the more concrete level, mission-oriented research and "grand challenges" to be achieved by a target date (e.g., 2030) could be similar to the following:

- Reduce GDP dependence on oil and gas exports by 50%
- Reduce relative economic dependence on natural resource sector by 50%
- Increase economic growth based on innovation (e.g., measured through multi-factor productivity increases) by 50%
- Reduce water consumption in resource extraction by 50%
- Reduce greenhouse gas production by 50%
- Develop and deploy self-healing pipelines that decrease by 80% the risks and effects of leakage
- Create 500,000 new high-tech, high-skill jobs outside the resource sectors
- Become a global top-3 exporter of clean technologies
- Become a global top-3 for net influx per capita of high-skilled labour

Alberta's CCEMC has taken steps toward establishing grand challenges aligned with Alberta's climate change strategy and movement toward a stronger, more diverse, and lower carbon economy. Such initiatives should be strongly supported and built upon.

Recommendation #3

about major initiatives related with the proposed economic transformation and system enhancement. These should be coupled directly to the planning and implementation work of the transition management team and Interim Board.

- For example, the government can look to its own track record of mission-oriented research to see how an economic vision can become a tangible program with broad participation and impact. AOSTRA remains a common reference point among Albertans today and is widely credited for the province's economic success in recent decades. This large-scale, long-term effort unified the province around a single, easy-to-understand goal. It was "made in Alberta" for a uniquely Albertan opportunity, and was unmatched in its long-term economic impact. However, both the province and the world have changed dramatically since AOSTRA's 1974 inception, and there has not been a similar initiative in Alberta since that time.¹⁶ Alberta needs a renewed sense of direction and urgency that rallies Albertans to a shared provincial vision for the 21st century. A series of new initiatives could then be announced at the end of the transition period and implemented within the new system. By doing so, the government will underscore the link between the proposed reorganization and the province's long-term priorities and challenges.
- Focusing on selected high-impact initiatives is critical. A province of four million people and with government R&D expenditure of less than 1% of GDP, Alberta cannot compete in all sectors and

industries. Rather, it must choose wisely where it competes, in line with the constraints of a resource-rich, low-population region. It is essential that Alberta establish a critical mass in select innovation areas, focusing on those in which the province either already possesses competitive advantage or in which it can achieve a competitive advantage within a reasonable timeframe. The province needs to accept that some areas of research are best left to other regions of Canada and the world.

- To identify and carry through these defining initiatives, Alberta must also look for synergies

“It seems to me the provincial vision for research and innovation lacks of a clear narrative and it is always changing.”

Online survey response from a member of Campus Alberta

and complementary opportunities with other Canadian provinces and the federal government. Canada as a whole benefits from Alberta's resource wealth but also bears the consequences of damages to the environment and to the country's reputation from certain forms of resource extraction. Alberta and Canada as a whole also share certain economic features, from their strong commodity base to U.S. market dependency. Alberta should assert its place among the other Canadian provinces and strengthen competitive sectors. It should not compete unnecessarily within Canada and duplicate efforts that have a significant head start elsewhere. Rather, Alberta should look to partner with other provinces. For example, the proposed

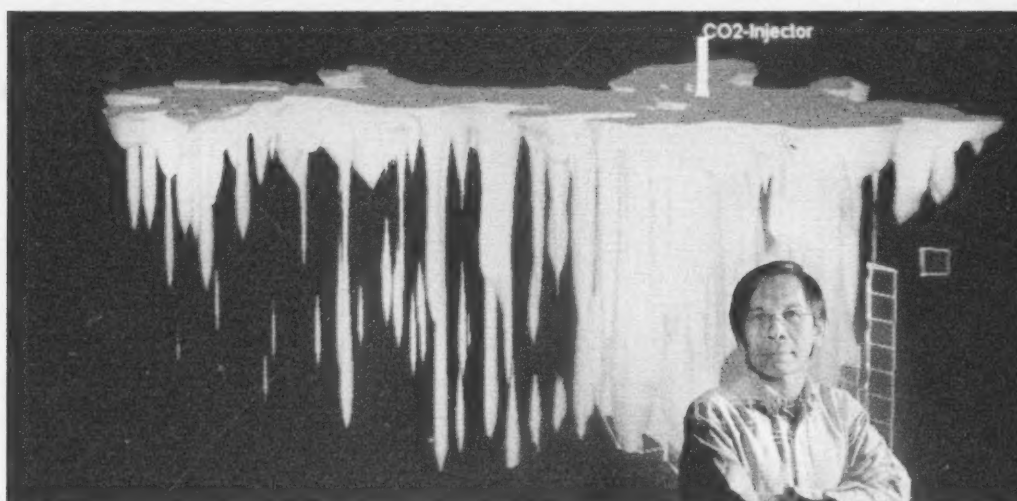
¹⁶ Some promising initiatives have been launched, such as the 2013 CCEMC Grand Challenge on carbon applications, but nothing even remotely close to AOSTRA in terms of magnitude or spirit.

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Alberta-Ontario Collaboration Agreement can help address and co-fund large-scale, sector-focused applied research projects that are priorities for both provinces. This initiative would engage researchers and have economic benefits for both provinces. Finally, Alberta should strive to align its innovation efforts with Canadian priorities to attract more federal research funds.

- The grand challenges that concern Alberta today have implications far beyond the here and now. Many of the world's regions, including other resource-rich jurisdictions with less research infrastructure and available talent, are looking to Alberta to take the lead on a number of humankind's most vexing 21st-century challenges: energy transition, environmental responsibility, economic diversification and resilience; social inclusion and intergenerational stewardship of resource endowments. We firmly

believe the province can provide global leadership on these issues. To realize its full economic and social potential, Alberta needs a bold vision that builds on past and present successes and leverages those successes to create the innovations and wealth of tomorrow.



Recommendation #4

[Recommendation #4]

Ensure that all key players of the innovation system work closely together and support the needs of the private sector. Develop a nimble, responsive, and accountable structure around a Management Body that serves as facilitator, connector, honest broker, and change agent.

This section provides recommendations for how to support better interactions among the private sector, Campus Alberta, and government based on specific opportunities we observed during our study. The recommendations should be taken as key considerations and guiding themes for the proposed system redesign.



Private sector

Private sector activity is the heart of wealth creation in most advanced economies, especially those centred on innovation. Innovation activities by the private sector - whether in corporate R&D departments, globally competing small- and medium-size enterprises, or by individual entrepreneurs - therefore need to be central to any effort to build a strong innovation ecosystem. It has been noted repeatedly, and affirmed by our study, that a key problem with innovation in Alberta and Canada is an approach based primarily on technology (or research) “push.”¹⁷ That is, governments focus on sponsoring research and translating that research into early stage companies through a variety of mechanisms, but frequently without a later-stage ecosystem in place to absorb the products from these emerging companies and support their growth. This points to an under-recognition of the importance of “market pull” mechanisms within the innovation system, whereby industry identifies needs that in turn stimulate research and development efforts.

¹⁷ See, e.g., the 2013 Report *Paradox Lost: Explaining Canada's Research Strength and Innovation Weakness*.

For a variety of reasons, Albertan and Canadian firms have not historically seen a need to invest in innovation, as evidenced by the quite low level of business investment in R&D.¹⁸ In many cases, these firms live off the low value-added but still profitable end of a commodity resource industry. Other firms have carved out a successful niche within the much larger U.S. market without aiming for global (or even North American) leadership *per se*. As a consequence, Canadian business leaders are risk averse compared to their U.S. counterparts, and their firms are less likely to assume the risks associated with translating new research discoveries into commercial products and using new technologies for their own processes.

The problem of lack of focus on firms, market, and business investment in R&D, each of which plays a key role in the innovation system, is expressed differently at different levels. Based on our analysis, we make the following five recommendations.

- **Create and support mechanisms to expand and grow startups as well as existing companies.** Alberta is a

thoroughly entrepreneurial province and has ample support and funding for fledgling startup companies from various sources. The picture is quite different, though, with respect to support when startup companies seek to achieve scale. Investors and entrepreneurs speak repeatedly of a “glass ceiling”, or limits to company size and revenue, imposed by a lack of both later-stage venture capital funding and global market integration. As a consequence, small companies do not have the means to grow within the province and frequently leave. While local investors may

nevertheless find investment in the province lucrative, it undermines Alberta’s long-term economic prospects, particularly the establishment of diversified industries.

- **Create incentives for multinational enterprises (MNEs) in new sectors to locate in Alberta to increase the province’s global reach.** MNEs are critical from a number of perspectives. They provide access to global supply chains and are crucial to the formation of local clusters of excellence. They drive directed R&D and employment, and create opportunities for synergistic startups and small- and medium-size enterprises (SMEs) to flourish in their

“To transform this vision into reality, we believe that the government must focus its efforts on the goal of growing innovative firms into larger enterprises, rooted in Canada but facing outward to the world and equipped to compete with the best.”

Jenkins Report, 2011

environment or be absorbed without losing their local presence. MNEs also bolster provincial visibility. Alberta must become known as a competitive supplier of certain technologies and knowledge-intensive services that are linked directly to the provincial vision and identified “grand challenges”. The government should make a decisive move to attract multinationals to the province to establish R&D centres and regional headquarters. This will require an orchestrated effort of policy interventions that span fiscal, labour, environmental, and other regulations (see Recommendation #5 for further discussion).

¹⁸ Ibid. and 2010 Alberta Competitiveness Report.

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- **Create incentives for natural resource industries to move up the value chain.** In many ways, Alberta's major industries have been complacent with their comfortable position and profit margins from exporting of raw materials, leaving the higher returns from high value-added products to other manufacturers around the globe. As mentioned earlier, given Alberta's very high GDP per capita, the province should be firmly in an "innovation-driven" stage of economic development. High wages and the associated standard of living will be sustainable only if businesses are able to compete by producing new and different goods using the most sophisticated production processes. This will require well-orchestrated innovation policies that go beyond research and commercialization to promote networking among innovators, establish robust industry clusters, and develop a financial system with strong angel and venture capital investment.

- **Add dedicated market-pull mechanisms to the innovation policy portfolio.** Market pull mechanisms are typically implemented starting from the demonstration phase of the classic research, development, demonstration and deployment/commercialization (RDD&D) paradigm. They typically include demonstration funding, tax incentives, grants and loans, technology support policies (including government procurement) and regulations. The Council of Canadian Academies¹⁹ has identified two significant market pull barriers that contribute to the relative lack of innovation occurring in Canadian firms:

- *Business support:* new ventures in Canada receive relatively little direct public funding support for development and commercialization of new technologies. The majority of public support for

industry R&D in Canada is provided through tax credits, rather than direct investment as found in other countries. For example, the absence of an SBIR²⁰-type program has been noted.

- *Public procurement:* The Canadian government has relatively few demand-side policies to encourage industrial R&D by creating markets for new technologies, products, or services. This is particularly relevant for provinces, where markets are smaller scale and a "one buyer" procurement policy could easily make the difference for commercial viability.

- **Create more synergies and matching programs with federal initiatives.** At the federal level, the Canadian government has recognized private sector underinvestment in R&D and has instituted a number of programs aimed at stimulating R&D investment in private firms, with a focus on transforming knowledge into commercial products. These programs support a policy objective to translate knowledge into innovative applications that help improve Canada's economic competitiveness and provide solutions to environmental, health, and social challenges. Several programs co-fund R&D projects in strategic areas of the economy where Canada has some significant strength and/or competitive advantage; they involve private sector firms working cooperatively with universities and government R&D laboratories. The Business-Led Networks of Centres of Excellence (BL-NCE) initiative is an example of a recent government program in this area, and has funded four-year business-led programs to reduce the environmental impact of aircraft and air travel and increase the competitiveness of Canadian aerospace firms; enhance oil recovery; develop value-added forestry products; and create pharmaceutical products.

¹⁹ See 2013 Report *The State of Industrial R&D in Canada* by the Council of Canadian Academies.

²⁰ The United States' Small Business Innovation Research (SBIR) program is a competitive program that encourages domestic small businesses to engage in Federal Research and Development that has the potential for commercialization.

Canada also supports SMEs through the Industrial Research Assistance Program (IRAP), which provides technical and financial support to SMEs for R&D projects associated with product and process development to improve competitiveness. Many of the firms assisted are small startups with fewer than 10 employees, with a focus on R&D and new products. This type of program is essential to support Alberta's SMEs, which are critical to having a private sector in the province that is led by innovation.

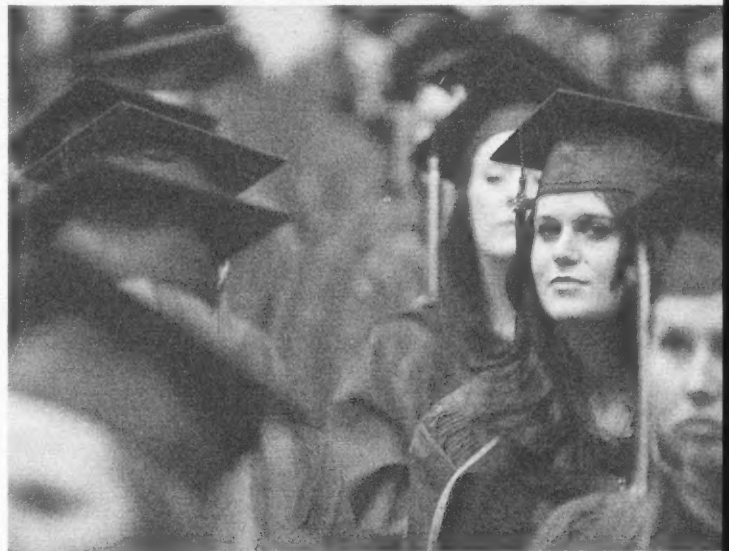
Campus Alberta

Campus Alberta institutions have made considerable headway in orienting their activities towards innovation and the specific innovation needs of the province's private sector. TEC Edmonton and Innovate Calgary are young but clear examples that bear witness to a nascent culture shift at the comprehensive academic and research institutions. The Polytechnic Institutions, NAIT and SAIT, have demonstrated great aptitude for attracting specific industry research and conducting accelerator-type enhancement of technology readiness. Many more promising examples can be found around the province within the Comprehensive Community Institutions. Jointly, the six sectors of Campus Alberta continue to be a strong source of a highly educated workforce in Alberta, particularly in critical engineering and technical vocational fields. Moreover, some provincial networks, such as the Regional Innovation Network facilitated by Alberta Innovates - Technology Futures (AITF), have been created and are beginning to have an impact, often greatly appreciated by participating Campus Alberta institutions.

Yet, much remains to be done within Campus Alberta to complete this shift. While the Expert Panel

encountered outstanding examples of successful faculty entrepreneurs, pockets of innovation success, and products spun out of universities, none have yet attained critical mass. Entrepreneurial faculty do not yet constitute a vocal and visible community, and entrepreneurial activities remain at the margins in institutions of higher education and research, which somewhat limits the economic impact these institutions can have. Generally, Campus Alberta institutions are more at the receiving end of the current innovation system's government-established structures and mechanisms rather than playing a role as one of the system drivers. We believe this must change, and we offer the following recommendations:

- **Enable a culture shift within academia - and give it a home.** Institutions of higher education and research are the drivers of knowledge and human capital generation and thus play a major role in all innovation ecosystems. Campus Alberta institutions must be enabled to adjust their missions for the 21st century, emphasizing the creation of concrete economic and social value for the province alongside their traditional mission of



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teaching and basic research. This includes, among other things:

- > Building and strengthening in-house competencies within Campus Alberta institutions to execute, grow, house, fund, and/or promote innovation activities. SAIT's Applied Research and Innovation Services, TEC Edmonton and Innovate Calgary lead the way.
- > Strengthening educational offerings, research, and mentoring activities at post-secondary institutions around innovation and entrepreneurship. International experience shows that entrepreneurship can be taught and greatly amplified by innovation-oriented research activity as well as seasoned mentorship. Some recent developments are opening up new possibilities for the province (e.g., the new Hunter Centre for Entrepreneurship and Innovation at University of Calgary, the Innovation Centre for Engineering currently under construction at University of Alberta, and emerging course offerings in Innovation and Entrepreneurship at University of Lethbridge);
- > Revising institutional policies to enable innovation, which includes institutional intellectual property (IP) policies (e.g., licensing, funding of patent applications), criteria for faculty hiring and promotion (e.g., have patents and industry research contracts factor in promotions), and time allowances (e.g., for faculty to spend time developing their startup companies);
- > Likewise, revising system-wide policies to support innovative and entrepreneurial activities, which includes creating a properly structured, consistent, and system-wide IP policy focused on "getting inventions out" rather than ownership that prevents the value of IP from being realized,

and extending merit criteria for grants to include industry research collaboration and startup company creation as important factors in addition to peer reviewed publications;

- > Emphasizing "use-inspired research" by identifying and articulating mission-oriented scientific activities and grand challenges (as proposed in Recommendation #3).

● **Encourage excellence by increasing competitive research funding for Campus Alberta institutions at the provincial level.**

Today, post-secondary institutions in Alberta receive most of their research funding from federal sources through competitive processes. Alberta's Ministry of EAE has a competitive research infrastructure grant program that is well aligned with the Canada Foundation for Innovation and that supports research infrastructure at Campus Alberta institutions. Nonetheless, much of the provincial research funding comes in the form of block grants or is earmarked for existing institutions such as the Alberta Innovates Centres, supplemented by some project, chair, or infrastructure funding through Alberta Innovates and other sources. Relatively little provincial funding is awarded competitively on a peer review basis, targeting research excellence in accordance with international best practices. We consider this a gap in Alberta's investment portfolio. Alberta's research institutions are ready to compete and prove their excellence. If Alberta wants to make innovation a priority, it is essential that the province increases the overall amount of research funding available - to match at least national average in terms of GERD/GDP²¹ - and allocates a significantly higher fraction through competitive mechanisms. Moreover, these grant mechanisms

²¹ In 2009, the share of Canada's GDP spent on Gross Expenditure on R&D was 1.9% but only 1.2% for Alberta.

²² Independent Panel on Federal Support to Research and Development (R&D), Innovation Canada: A Call to Action ("Jenkins Report"), 2011; see the discussion of the "whole-of-government" approach throughout.

should be aligned with federal priorities and programs to maximize the amount of federal program funding attracted to Alberta.²⁷

- **Target funding towards collaboration to achieve critical mass within the province.** The province and its public research institutions cannot compete on a world-class level across the board and must choose areas of engagement wisely. For many individual institutions, it is unlikely they can achieve critical mass on their own, even if they possess visible niches of excellence. For a province with multiple strong institutions and a history of intra-provincial competition and duplication, collaboration is essential.²⁸ We therefore recommend that funding instruments be purposefully aligned with the key priority areas and designed to encourage collaboration among all Campus Alberta institutions as well as between Campus Alberta institutions and industry, domestic partners from other provinces, and international partners.

By creating networks of excellence that unite the strongest research laboratories from across the province around a single goal, the province has a higher chance of succeeding in a globally competitive research environment. Recommendation #6 proposes a potential mechanism.

- Related to the two previous points about competitive funding and greater collaboration is our recommendation to **reduce friction and duplication within Campus Alberta.** Although competition motivates a drive to excellence, too much redundancy, parallelism, and rivalry can be counterproductive. Points of friction exist, for example, between different regions, between

Comprehensive Academic Research Institutions (CARIs) and the Polytechnics, or the CARIs and “the rest.” Our consultations show that there is a genuine desire for Alberta’s academic institutions to work together, but that role clarity and direction are needed from the government. The province needs Campus Alberta to work as a system. Through the Management Body and the preparatory work of the Interim Board and transition management team, the province has the

“There is a genuine will for Alberta’s academic institutions to work together, but role clarity and direction are needed from the government.”

opportunity to develop a set of new policies and programs that strike a balance between competition and collaboration. They will enable Campus Alberta to collaborate where it makes sense from an efficiency point of

view, particularly where a critical mass of skills is important and the scale of the research requires multiple dimensions of investigation.

On a larger scale, the Universities of Calgary, Alberta, Lethbridge, and Athabasca should be encouraged to compete at a national and international level - jointly when appropriate - especially given the modest amount of federal grants Alberta attracts compared to other provinces. At the provincial level, universities should team up to combine their strengths in critical areas for the province such as energy and environment, and otherwise strive for excellence according to their distinctive strengths. The articulation of strategic plans by the universities is an important first step in this direction, but it has to go much further.

²⁷ A similar rationale was the basis for a recent program in Portugal that has received much international acclaim. The program funds the country’s leading institutions to partner with eminent U.S. research universities (including MIT, Harvard, Carnegie Mellon, and University of Texas-Austin) on key priority areas. In a 2012 review by the Finnish Academy, these programs were commended for their bold approach and success in creating critical mass in research, education, and innovation across the country.

- In many ways, polytechnic institutions in Alberta have led the way in being relevant and responsive to industry needs and are demonstrating impressive successes both in attracting research funding and providing human capital to growing industries. Academic institutions can learn from these successful interactions with industry. Baccalaureate and Applied Studies Institutions and Comprehensive Community Institutions perform equally critical functions for the system that should not be discounted. Campus Alberta institutions made clear during our consultations that they are eager to support a comprehensive innovation agenda for the province - ranging from interdisciplinary technology solutions to targeted human resource development to business and social innovation - if they are given an opportunity to build on their strengths and are assured of financial and organisational stability over the long term. The government should continue to strengthen the differentiated roles in a unified Campus Alberta system - roles the individual institutions are eager to fulfill if well specified.
- **Basic research should remain a key concern of Campus Alberta funding.** Applied research and commercialization are bound to remain empty ambitions if not nourished by excellent and diverse basic research. We believe strongly that excellent basic research alongside mission-oriented and entrepreneurial applied research and development, together with the right environment for scale, are essential elements for Alberta's success.

Government

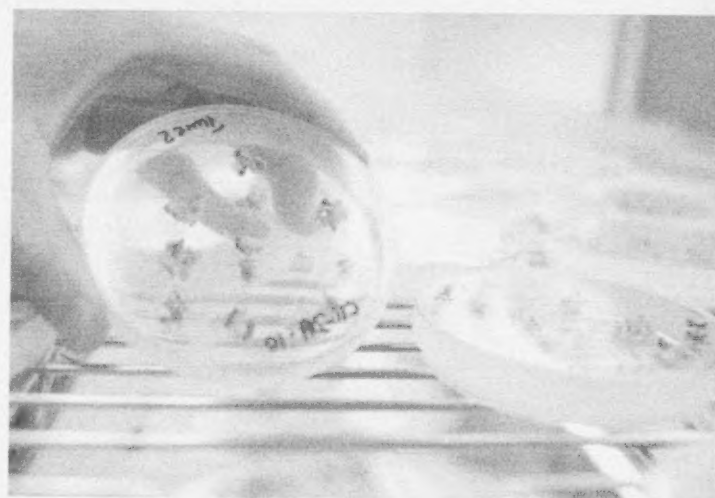
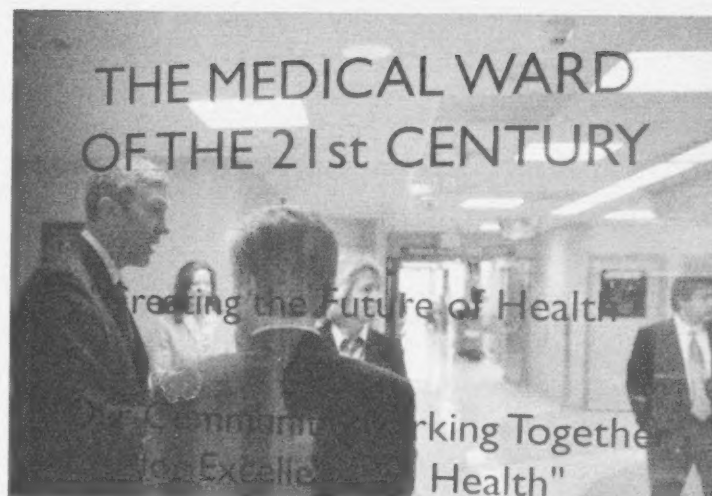
Alberta's public innovation system lacks a central, agile entity that serves as a true honest broker and facilitator between Campus Alberta institutions and industry. Campus Alberta institutions and faculty lament that funding, translation, and networking opportunities for innovation are fragmented and not well aligned across ministries and the Alberta Innovates corporations, are bureaucratic in the determination of merit, and, above all, are unresponsive to emergent opportunities - all key barriers to entrepreneurship. We heard from stakeholders repeatedly that inefficiencies and confusion about funding access have led to missed opportunities for promising investment in areas aligned with Alberta's priorities and long-term goals. Industry and Campus Alberta institutions must be left to identify opportunities, with government institutions facilitating their interactions. The government should not be dictating innovation opportunities moving forward. Rather, there must be a new structure that is nimble, responsive, and can broker opportune interactions.

Oversight and critical accountability are needed. Too many organizations try to claim the territory of funding and facilitating innovation, which creates confusion, duplication of effort, and resource inefficiencies. At present, there is no authoritative map of the Alberta innovation system. The system comprises hundreds of entities - including many organizations under ministries, many elements within Campus Alberta, regional or municipal-level service providers, NGOs, investor organizations or networks, and federal entities, among others - many (though not all) of which receive provincial funding of some sort, and many of which are co-hosted or co-sponsored

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through several organizations simultaneously (such as TEC Edmonton, Innovate Calgary, or Mitacs). There is little understanding among stakeholders with whom we consulted of how these pieces fit together, where functions reside, and which entities should be approached for specific needs. Funding through the system follows contorted, cyclic paths, limiting oversight and accountability. Furthermore, some of the programs have a federal mandate and are not necessarily responsive to the priorities of Alberta.

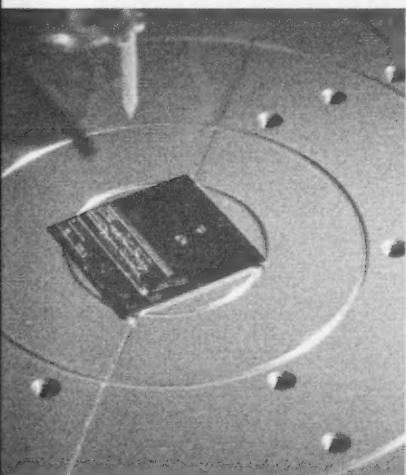
- We recommend the Interim Board and transition management team **develop an accurate system map** that includes funding streams. In line with our earlier recommendations regarding strategic oversight and alignment, we emphasize that a better system map will help Alberta make decisions about areas of under- or over-investment, and will show how to strengthen overall system efficiency. It can help in developing better metrics to track provincial expenditures (see Box 5).
- Closely related to this, we recommend that the Interim Board and transition management team work to **provide a single access point to the system and its resources** – a kind of “one-stop shop” for key information, services, facilitation, and connectivity. This will help organizations and individuals navigate the rather complex system. In Alberta, this central access point must be provided by the government, especially given that there is no single state-owned company that centralizes expertise and services. The Management Body should establish an office that serves as the system’s central information node and connector. It should build on Alberta Innovates Connector launched in 2010, as well as other networks run by various government and non-government organizations (e.g., the AITF Regional Innovation Networks or Petroleum Technology Alliance Canada, PTAC), as well as federal organizations



(e.g., Mitacs). In some cases, it may be appropriate to consolidate provincial networks into the Management Body’s single access point.

Embracing a true, effective, and accountable honest-broker model also implies demarcating the mission of the Management Body. The Ontario Centres of Excellence (see Box 6) made a decisive move by not directly engaging in research but rather focusing on serving as Ontario’s central innovation hub. Alberta will need to make a similar choice (as discussed in Box 3).

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Box 5: Suggested activity during the transition period: Conduct an innovation landscape study

It is important to conduct an innovation landscape study among companies, industry organizations, and Campus Alberta institutions to ascertain their existing long-term strategic goals, investment focus areas, and primary inter-organizational links. This study, which would be conducted as a survey, has two purposes. The first is to paint a picture of how the many players in the province's innovation system see themselves evolving, both individually and as part of a system. This picture will reveal the degrees to which players are interconnected, informed, and aligned with provincial ambitions. The second purpose is to identify innovation domains worthy of focusing the province's resources, which could parallel an effort to determine candidates for one or more "grand challenges" (see Recommendation #6).

Great effort has been made by many of Alberta's organizations, notably Campus Alberta institutions, to plot a strategic course and plan their growth (see, e.g., the University of Calgary Energy Research Strategy titled *Energy Innovations for Today and Tomorrow*, published in September 2013; the University of Alberta 2012 *Comprehensive Institutional Plan*). In some cases, these plans include assumptions about the direction the province will take and about the current Alberta innovation ecosystem or what it may become. The survey should solicit a range of answers, from quantified performance targets to aspirational goals for provincial economic, social, and environmental outcomes over the coming decades. This information is essential to taking full advantage of existing strengths in the system, and thus an integral element of the ongoing consultation process.

The same organizations should also be assessed regarding their inter-organizational relationships. This survey should directly feed a system mapping effort that will build on work done by AITE. For example, a university research centre may list its contacts at an Alberta Innovates corporation and two or three local businesses, describe how some of the links were formed through occasional contact with Innovate Calgary, and indicate the magnitude of funding streams from each. Beyond assessing the current situation, the survey should seek input regarding how an organization's interactions with other elements of the system might be improved or facilitated. For instance, the survey might ask: How could a province-wide innovation planning body help your organization participate to the best of its ability in a bottom-up system guided by a long-term provincial innovation strategy? A network map should be established and evolve as the Management Body considers changes to the system.

Box 6: The Ontario Centres of Excellence - a Canadian peer organization

The *Ontario Centres of Excellence (OCE)* is considered a success throughout Canada. This organization consolidates all provincial government functions of business links, startup incubation, and connections with academic research facilities. OCE serves as the "honest broker" between participants by measuring their performance in terms of technical excellence as well as critical economic development outcomes such as job creation, exports, increased industry sales, growth in the provincial priority areas, and follow-on venture capital financing. This network has matured over decades, much like the networks currently distributed throughout Alberta's government. Yet, OCE's centralized organizational structure allows it to act as a single portal for industry, eliminating information gaps and uncertainty about processes while fostering confidence. OCE features "vouchers" that can be exchanged for expertise, services, and resources. The vouchers are established based on provincial research priorities and offer funding from provincial and federal programs, and projects are monitored against desired outcomes set in advance.

The March 2013 Ontario budget addressed the need for Ontario to develop a "Made in Ontario" program that specifically addresses internship and fellowship opportunities in Ontario sector priorities, to be managed by the Ontario Centres of Excellence, as opposed to relying on the generic federal Mitacs programs. A similar "Made in Alberta" program should be considered.

In 2013, OCE undertook key initiatives in sectors that are of priority to the Province of Ontario and may be programs for Alberta to consider. These included:

- A joint initiative that included IBM, the province, and the federal government that has resulted in more than \$260 million being invested in high-performance computing resources in Ontario. The goal is to make Ontario one of the regions in North America supporting big data applications in key sectors of importance to the province, including medical discovery, manufacturing, energy, and information technology.
- An Industry Association program that provides funding to sectors such as energy, aerospace, manufacturing, and medical discovery to develop platform technologies to assist these entire industry sectors in Ontario by sharing the results of the relevant industry/academic research undertaken with all companies in the particular sector. These initiatives could lead to significant future "grand challenge" opportunities for the province.
- Significant financial and resource support for all of the universities and colleges in Ontario to provide entrepreneurial training and to create additional incubators beyond the current nine, to support academic spin-off companies.

[Recommendation #5]

Apply a wide range of policy measures to foster innovation, recognizing that innovation policy has a much broader purview than science policy.

Canadian academic research is strong and well regarded internationally, as is widely acknowledged in several government publications. Canadian business innovation, though, is weak by international standards. The 2013 *Paradox Lost* report by the Council of Canadian Academies has traced this shortcoming in innovation performance to a conflation of innovation policy with science or research policy. As discussed in Box 1, the latter traditionally covers mainly the supply side of innovation, while innovation policy covers a much wider array of issues to ensure the seamless functioning of complex innovation systems.²⁴ Along these lines, and as suggested by the Council of Canadian Academies, the principal objectives of Canada's innovation policy moving forward must be to:

- Create or amplify the market signals that will encourage firms to adopt innovation-based strategies, e.g., market framework and procurement policies; and
- Improve the capacity of the innovation ecosystem to support firm-level innovation primarily by aligning and strengthening the connecting links among institutions, policy domains, and jurisdictions.

A true innovation policy approach that transforms Alberta's economy thus involves more than merely organizationally restructuring the public sector institutional landscape and launching new initiatives, programs, or projects. It ties into many adjacent policy areas that must be considered as part of an integrated, whole-of-government innovation agenda. Specific issues requiring detailed consideration include:

- **Competitiveness policies:** Trade policy and trade agreements (e.g., in terms of market access, red tape, or tariffs); sector-specific subsidies; access to capital (e.g., public venture capital and IP policies). For example, the recently announced Canada-EU Free Trade agreement will affect virtually every industry in the country, including Alberta's beef and agriculture industries, and it will allow EU firms to bid on sub-national public procurement. It will also likely affect recognition of professional standards and hence labour mobility.²⁵
- **Fiscal policy:** Tax policies (e.g., for firm relocation); other tax revenues (e.g., other government revenues utilized for applied research and development funding, such as CCEMC); procurement policy (e.g., by supporting local

²⁴ Lundvall, Bengt-Åke, and Susana Borrás. 2006. "Science, Technology and Innovation Policy." In *The Oxford Handbook of Innovation*, edited by Jan Fagerberg, David C. Mowery, and Richard R. Nelson, 1st ed., 1:599-631. Oxford, England: Oxford University Press.

²⁵ "Why the Canada-EU Trade Deal Will Affect Almost Every Industry." *The Globe and Mail*, Oct 18, 2013.

industries or in monopsony sectors); direct or indirect subsidies (i.e., sector-specific grants or infrastructure subsidies). For example, the more than 30% increase in per-capita public spending between 1999-2000 and 2010-2011 (\$7,505 to \$10,240) was accompanied with a \$150 per capita decline in tax revenue. The difference has been made up to a large extent through oil and gas exports, thus undermining the broader goal for sustainable intergenerational resource stewardship.²⁶

- **Broader environmental, health, safety, and technical regulations** (e.g., environmental standards or technological standard setting). The CCEMC is a good example of a cap & permit-type emission reduction regulation - the first of its kind in North America - and is widely credited for its boldness and success.
- **Human resource policy:** immigration policy (e.g., work permits or student visas), labour law; education policy (including K-12). For example, the federal Start-up Visa program was launched in October 2013, and Innovate Calgary is one of five centres approved to support the program. Alberta should leverage this program to attract entrepreneurs and other highly qualified people to the province.
- **Consideration of other jurisdictions:** such as Alberta's benefits, obligations, and competitive advantage within Canada (e.g., as recipient of federal research funding) and North America (e.g., as member of NAFTA). It also includes consideration of federal priorities and, in particular, funding programs that align with Alberta priorities. For example, OCE runs federal

programs that are synergistic with Ontario priorities for NSERC, IRAP, Connect Canada, and so on. This "whole-of-government approach" assures that Ontario obtains maximum federal funding. The same model could be used in Alberta, especially since Alberta attracts disproportionately low amounts of federal research funding.

Several measures have already been taken by the Alberta Competitiveness Council and are outlined in *Moving Alberta Forward*, published in 2011. These measures focus on overall provincial competitiveness; some specific activities benefit agriculture, financial services, manufacturing, chemicals, and petrochemicals. Through the Advisory Body, the government will have a vehicle to orchestrate innovation policy from a broader perspective than just research and development funding. As a standing forum that includes members of the Cabinet alongside representatives of industry, academia, and other parts of the innovation system, the Advisory Body will be able to incorporate a broader scope of issues and draw upon national and international best practices to address them. With innovation at the centre of Alberta's economic development, it is an essential matter of attention for the entire government.

²⁶ See Emerson Report.

Recommendation #6

[Recommendation #6]

Balance top-down directives with bottom-up initiatives. Work towards launching one or more initiatives that help build critical mass from the ground up and enroll key actors in developing a long-term strategy.

Many of the previous recommendations have focused on reorganizing the Alberta innovation system to achieve greater alignment, focus, and impact. This top-down structural intervention is necessary to address clear system deficiencies in the short term, but is not sufficient to ensure innovation success in the long term. Innovation depends as much on entrepreneurial bottom-up activity, individual and collective creativity and formation of regional knowledge clusters, creative and destructive market forces, and continuous openness as it does on the appropriate system framework and top-down government oversight. Hence, the transition process must be careful not to stifle bottom-up activity along the way but lay the groundwork for new, competitive processes that will, however, ensure alignment with the proposed transformation and vision for years to come.

- The vision and grand challenges will help the province bring out its strengths. Yet, care must be taken not to rely entirely on top-down mechanisms to advance innovation in Alberta. While there are good arguments for strategic government investment in industries and key technologies, attaining critical mass, and focusing on currently strong sectors, there are equally good arguments

for diversification away from those sectors and for stimulating self-formation of clusters of excellence. At present, the Alberta innovation system includes elements of both bottom-up and top-down approaches. While there are examples for either approach (e.g., Singapore for top-down, the United States for bottom-up), Alberta's dual imperative of exploiting visible strengths while exploring new areas for diversification demands a balanced approach to optimize economic growth and sustainability. No one can predict precisely which areas will be important in the decades to come or what research will support the main industrial thrusts. Accordingly, there must be a focus on innovation foundations that will allow competitive industries to develop.

- We therefore recommend the government launch a number of bottom-up initiatives following establishment of the Management Body (see Box 7 for an example). These initiatives should be strongly linked to and help determine the province's strategic strengths and priorities. This suggestion is directly in line with our discussion of competitive research funding at the provincial level, presented in Recommendation #4.

Box 7: Embracing bottom-up: An idea for a multi-stage competitive process for self-formation of collaborative clusters of excellence between academic institutions and industry around “grand challenges.”

Several countries have recently been emphasising competitive calls for collaborative proposals to stimulate the bottom-up formation of clusters of excellence. For example, Germany has launched a system-wide Excellence Initiative to increase internal differentiation, specialization, and clustering of competencies among its universities. Portugal, in a bid to build national critical-mass research clusters, has issued calls for applied and test-bed research in the context of several international partnerships with leading U.S. research universities. Alberta could utilize similar multi-stage, bottom-up processes to articulate strengths in strategic priority areas.

The process could begin with a call for preliminary proposals, potentially supported by a limited amount of funding. Part of each entry should be a brief description of how the proposed project (whether basic research or product development) would contribute to a province-wide challenge that could grow into a large-scale economic driver. Some broad categories might facilitate the process, but the solicitation should be open ended, allowing proposers to articulate the challenge to be addressed. The call should have a strong emphasis on collaboration. From the range of submitted proposals, the strongest ones could be grouped into emerging thematic areas and the relevant parties be invited to submit full proposals for the next round of the competition. Proposing teams should be required to include academia alongside industry, public laboratories, government and non-government organizations, and potentially international partners. The Management Body should establish success criteria and oversee judging.

The input from such a competition could be integrated into the Management Body's work to identify and refine grand challenge candidates, along with input from ongoing stakeholder engagement.



Conclusion - A look into the future

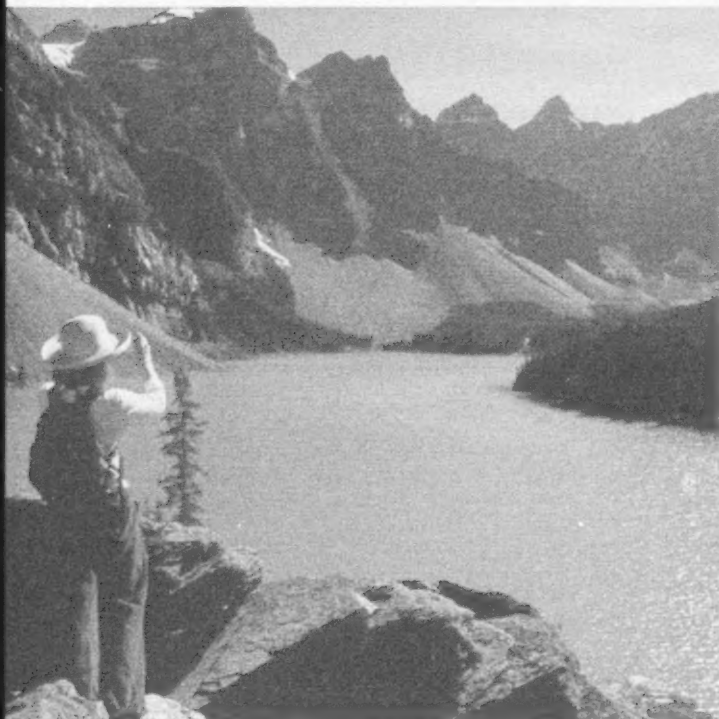
Members of the Expert Panel are honoured to have had the chance to deliberate on an Institute initiative that can truly transform Alberta's innovation system. Rather than repeat in this concluding section the specific recommendations made throughout the report, we offer a speculative glance at what Alberta will have achieved after implementing these recommendations.

In 2013, the province boldly seized a unique opportunity to secure prosperity in the coming decades by taking the next critical step in its socioeconomic evolution and turning its comparative advantages into sustainable competitive advantages. Alberta mustered its economic strength, bright talent, strong institutions, and entrepreneurial

spirit behind a comprehensive commitment to innovation at a time when support for transformational change was at the highest level since the province began reaping the benefits of AO STRA.

In 2014, Alberta undertook a targeted restructuring of its innovation ecosystem that was aligned synergistically with existing development initiatives in the province - and in doing so breathed new life into stalled efforts to create a more productive and efficient system. The Premier and Deputy Premier took ownership, through a newly created high-level Advisory Body, of a powerful long-term vision to enable Alberta's future prosperity through innovation. This Advisory Body filled a critical gap by making innovation the concern of the entire government and providing a forum for Alberta to deliberate and define an innovation strategy for the province. At the same time, following international best practice, the province centralized the management of its innovation investments and programs in a single Management Body. This body became the standard-bearer and main implementer of the province's vision for technology and innovation, a strong champion for broader regulatory and policy changes that were much needed, and a nimble orchestrator serving the many different actors in the system.

Through this two-fold strategy, the government provided the necessary vehicle to transform the Alberta innovation landscape, add clarity and purpose to the many excellent activities in the province, and provide simplified access to the government's innovation services. It tied together interests and capacity of industry, Campus Alberta, and government in an unprecedented way and sowed the seeds of a culture shift towards a nimble, knowledge-intensive economy based on innovation and entrepreneurship.



Conclusion - A look into the future

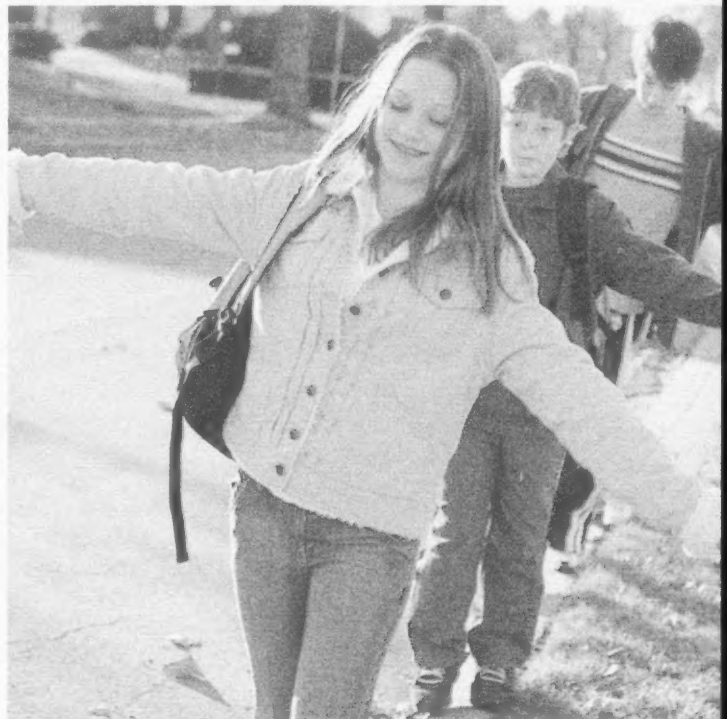
This audacious restructuring marked the beginning of an iterative process of continuous consultation with key actors involved in innovation across the province, and set the tone for years of trustful relationships. It was a remarkable reversal after past initiatives in Alberta had shown symptoms of wavering public support. This renewed the critical social licence for the use of Alberta's natural and intellectual resources, and contributed to an understanding that innovation would benefit all citizens in all parts of Alberta for decades to come.

Between 2014 and 2016, Alberta launched a number of flagship initiatives that successfully addressed some of the province's and world's most pressing challenges and catalyzed tremendous technological advancement. These initiatives were built in part on bottom-up programs that defined future strengths and priorities in line with overall provincial goals. By engaging in the right processes at the right time, the province realized significant returns on its investments. A generation later, Albertans were already citing 2014 as a reference point: it was the time when a visionary provincial government made a unique commitment to the province's socioeconomic wellbeing that created a higher quality of life for all Albertans, assuring prosperity for generations to come.

The momentum unleashed in 2014 helped craft a 21st-century identity for the province. Just as Silicon Valley had leveraged its technological advantages - in combination with close-knit networks of entrepreneurs, venture capitalists, and researchers - to occupy a "mind-space" around access and use of information, Alberta seized the opportunity to occupy its own unique mind-space. From our future vantage point, we see a province to which the world now turns for leading energy and

environment research; where the world's most challenging oil and gas extraction is done with the highest standards for environmental sustainability; that has redefined the meaning of health services for 21st-century citizens; and where agricultural innovation is ensuring the world's growing billions are fed.

Yes, in this future Alberta may still be a "small" Canadian province, but it is one that conveys a big message thanks to the innovation of its businesses large and small, its world-class academic institutions, its forward-looking government, and its entrepreneurial spirit. That message is: through global leadership and innovative success, the world looks to us for solutions to some of its toughest challenges.





Appendices



Expert Panel Members and UVI Team

Expert Panel Members

Dr. Daniel Roos (Chair)

Japan Steel Industry Professor Emeritus of Civil and Environmental Engineering and Engineering Systems, Massachusetts Institute of Technology; President, University Ventures International (UVI)

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President and Chief Executive Officer, Ontario Centres of Excellence; Vice-Chairman of the Board, Alberta Innovates Technology Futures; Chair, oneeleven Big Data Accelerator; Board Member, Waterloo Research and Technology Park - Accelerator; Board Member C-FER Technologies Inc.

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Member, Alberta Research and Innovation Authority; Member, Innovation Australia and Chair, Innovation

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The Expert Panel was supported in its effort by University Ventures International.

Dr. Sebastian Pfotenhauer**Dr. Fred Moavenzadeh****Dr. Steven Griffiths****Mr. Ephraim Lanford**

Government of Alberta

The Expert Panel gratefully acknowledges the support received from the Ministry of Enterprise and Advanced Education and the Division for Innovation & Advanced Technologies. We are particularly grateful to Assistant Deputy Minister Mel Wong, Lisa Bowes, Jutta Rohrschach, and Liz England for their support of the consultation process and Expert Panel meetings. We further express our gratitude to Deputy Premier and Minister of EAE Thomas Lukaszuk and Deputy Minister of EAE David Morhart for their invaluable input.

List of consultation meetings

Government of Alberta / Portfolio Advisory Committee Ministers

Name	Title	Affiliation
The Honourable Thomas Lukaszuk	Deputy Premier and Minister	Enterprise and Advanced Education
Mr. Warren Singh	Chief of Staff	Office of the Deputy Premier and Minister, Enterprise and Advanced Education
Mr. Gord Johnston	Assistant Deputy Minister, Advanced Learning and Community Partnerships Division	Enterprise and Advanced Education
Mr. Justin Riemer	Assistant Deputy Minister, Economic Competitiveness Division	Enterprise and Advanced Education
Mr. Mel Wong	Assistant Deputy Minister, Innovation and Advanced Technologies Division	Enterprise and Advanced Education
Ms. Lisa Bowes	Executive Director, Innovation Support Systems and Services Section	Enterprise and Advanced Education
Ms. Jo-Ann Hall	Assistant Deputy Minister, Industry and Rural Development Sector	Agriculture and Rural Development
Mr. Martin Chamberlain	Assistant Deputy Minister	Energy
Ms. Victoria Bachmann	Executive Advisor, Policy Management Office	Energy
The Honourable Diana McQueen	Minister	Environment and Sustainable Resource Development
Mr. Jerry Keller	Manager, Research and Partnerships	Environment and Sustainable Resource Development
The Honourable Fred Horne	Minister	Health
Mr. John Sproule	Executive Director, Policy and Stakeholder Relations	Health
Mr. Stephen LeClair	Assistant Deputy Minister, Economics and Fiscal Policy Division	Treasury Board and Finance

Ministry of Western Economic Diversification

Name	Title	Affiliation
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Ms. Jerra Kosick	Chief of Staff	Western Economic Diversification
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Alberta Innovates - Technology Futures

Name	Title	Affiliation
Mr. Stephen Lougheed	President and Chief Executive Officer	Alberta Innovates – Technology Futures
Mr. J.D. Gilpin	Board Member	Alberta Innovates – Technology Futures
Mr. Cory Fries	Vice-President, Corporate & Legal Services, and Corporate Secretary	Alberta Innovates – Technology Futures
Mr. Barry Mehr	Vice President, Food & Agriculture	Alberta Innovates – Technology Futures
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Ms. Kathleen Sendall	Vice-Chair	Alberta Innovates – Energy and Environment Solutions
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Alberta Research and Innovation Authority

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Dr. Marvin Fritzler and Members of the Authority	Chair	Alberta Research and Innovation Authority

Campus Alberta

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Dr. Daniel Doz	President and Chief Executive Officer	Alberta College of Art and Design
Dr. Dianne Taylor-Gearing	Vice-President Research and Academic Affairs	Alberta College of Art and Design
Dr. Randy Poon	Chair of Business Programs	Ambrose University College
Ms. Margaret Mrazek	Member of the Board of Governors	Athabasca University
Dr. Alex Kondra	Vice-President Academic (Acting)	Athabasca University
Dr. Donna Romyn	Associate Vice President, Research (Acting)	Athabasca University
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Dr. Bruce Rutley	Director, Centre for Research and Innovation	Grande Prairie Regional College
Dr. Kevin Nagel	President and Chief Executive Officer	Keyano College
Dr. Tracy Edwards	President and Chief Executive Officer	Lakeland College
Ms. Alice Wainwright-Stewart	Vice-President, Academics, Research and Innovation	Lakeland College
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Mr. Lorne MacGregor	Director of Applied Research and Innovation	Lethbridge College
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Appendix 2

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Dr. Jodi L. Abbott	President and Chief Executive Officer	NorQuest College
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Mr. Todd Odgers	Associate Director, Centre for Excellence in Intercultural Education	NorQuest College
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Mr. Brad Hestbak	Senior Director, External Relations	Northern Lakes College
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Ms. Tanya McDonald	Associate Vice President, Research and Learning Enterprises at Olds College	Olds College
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Mr. Eric Kokko	Director of Applied Research and Innovation	Red Deer College
Dr. David G. Ross	President and Chief Executive Officer	Southern Alberta Institute of Technology
Dr. Gordon Nixon	Vice-President, Academic	Southern Alberta Institute of Technology
Dr. Alex Zahavich	Director, Applied Research and s Innovation Service	Southern Alberta Institute of Technology
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Dr. Glen Baker	Associate Vice-President (Research)	University of Alberta
Dr. M. Elizabeth Cannon	President and Vice-Chancellor	University of Calgary
Dr. Mike Mahon	President and Vice-Chancellor	University of Lethbridge
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Health and Tech Industry and Enterprise

Name	Title	Affiliation
Mr. Perry Kinkaide	Founder and Past President	Alberta Council of Technologies
Mr. Stuart Lomas	President	Alberta Council of Technologies
Ms. Tricia Cisakowski	Chair, Board of Directors	Alberta Health Industry Association (AHIA)
Ms. Tracey Scarlett	Chief Executive Officer	Alberta Women Entrepreneurs (AWE)
Ms. Amanda Stadel	Chief Executive Officer	Bio Alberta
Mr. Stewart Roth	President and Chief Executive Officer	Guardian Chemicals Inc.
Mr. Wes Zaboschuk	Associate Chair, Marketing	Northern Alberta Institute of Technology
Mr. Russel Matichuk	President	SUMEX Capital
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Economic Development Organizations and Innovation Service Providers

Name	Title	Affiliation
Mr. Ken Brizel	Chief Executive Officer	ACAMP
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Appendix 2

Energy Industry

Name	Title	Affiliation
Mr. Matt McCulloch	Board Member	Alberta Clean Technology Industry Alliance
Mr. Larry Staples	Project Manager	Alberta Chamber of Resources
Mr. Bill MacFarlane	Former President	Canadian Heavy Oilsands Association (CHOA)
Mr. Gerald Bruce	Former President	Canadian Heavy Oilsands Association (CHOA)
Dr. Subodh Gupta	Chief Technology Development	Cenovus
Mr. Rick Gallant	Vice President, Oilsands Research	Imperial Oil
Dr. Ian Potter	Vice-President, Engineering and Business Management	National Research Council (NRC)
Mr. Ken James	Co-President and Co-Chief Executive Officer	Oak Point Energy
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Ms. Levenne Louie	Vice President, Land	QuickSilver
Mr. Mykola Makowsky	Project Engineer	Western Hydrogen
Mr. Wayne Karpoff	President	Willowglen Systems
Ms. Gail Powley	Vice President, Corporate Development	Willowglen Systems
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Venture Capital and Alberta Industries

Name	Title	Affiliation
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Mr. Mark Carlson	Vice President, Investment	AVAC Ltd
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Mr. Joe Lukacs	President & Chief Executive Officer	CETAC WEST
Ms. Margaret Kelly	Vice President	CETAC WEST
Mr. James Chepyha	Vice President of Investments	Chrysalix Energy Venture Capital
Mr. Greg Ogrodnick	Chief Executive Officer	Circle Cardiovascular Imaging Inc.
Mr. Kelly Cherniwchan	Chief Operating Officer	Circle Cardiovascular Imaging Inc.
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Ms. Heather Herring	Vice Chair of the Board of Directors	TECTERRA
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Ms. Anouk Kendall	President	WADE Canada
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Ms. Connie Phillips	Executive Director, Research and Innovation Strategy	Agriculture and Rural Development
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Ms. Laura Polasek	Project Manager	Agri-Environmental Partnership Alberta (AEPA)
Ms. Sharon McKinnon	Policy Program Coordinator	Agri-Environmental Partnership Alberta (AEPA)
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Ms. Kara Barnes	Market Development Coordinator	Alberta Barley Commission
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Appendix 2

Faculty entrepreneurs

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Dr. Stephen Larter	Professor, Department of Geoscience	University of Calgary
Dr. Frank Maurer	Associate Vice President (Research)	University of Calgary

Other Consultations

Name	Title	Affiliation
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Dr. Bob Church	Chair Emeritus	Alberta Science and Research Authority
Dr. Robert Sutherland	President	Confederation of Alberta Faculty Associations
Dr. Arvind Gupta	CEO & Scientific Director	MITACS
Ms. Christine Gilles	Director for Alberta	MITACS
Dr. Carl Amrhein	Provost, VP Academic	University of Alberta (on leave at Conference Board of Canada)
Dr. David Lynch	Dean of Engineering	University of Alberta
Dr. Doug Miller	Dean, Medicine/Dentistry	University of Alberta
Dr. Lorne Taylor	Former Minister	(former) Department of Innovation and Science (Government of Alberta)

Alberta SWOT Analysis

Strengths

- High current economic strength and strong future growth potential
- High quality of living and income
- Strong and democratic institutions
- Broad range of small and medium companies
- Well-trained human capital and net influx of labour force
- Substantial investment in higher education
- Proven track record in successful R&D for oil sands technology (AOSTRA)
- Government commitment to diversification of the economy
- Plethora of funding opportunities
- Good integration with the US market and success in niche industries

Weaknesses

- Economy built on natural resources with little development of value-added products
- Low business investment in R&D
- Few multinational corporations headquartered in Alberta
- Limited access to global supply chains
- Low labour productivity growth and multi-factor productivity growth
- Overly complex and cluttered innovation system with duplication, mission creep, and lack of clarity on roles and responsibilities
- Historical organizational functions live on in today's system
- Distance from major export markets other than the United States
- Dependence on, and tight coupling with, the U.S. market for export of commodities
- Challenges to resource stewardship: resource revenues are used to fill budget holes, not to invest in future generations
- Lack of venture capital funding

Opportunities

- Political and societal urgency for major initiatives and evolution of the economy for future prosperity
- Robust natural resource commodity exports that can be translated to value-added products
- Sufficient capital to develop and grow other competitive sectors, particularly in R&D-intensive industries
- Government commitment to provide necessary resources for the diversification of the economy
- Spirit of entrepreneurship
- Global leadership in environmental sustainability management; world is looking to Alberta to take the lead

Threats

- Dangerous dependence on non-renewable hydrocarbons for economic prosperity
- Fluctuation in resource commodity prices
- U.S. energy independence through shale oil and shale gas development
- Deployment of lower-cost and cleaner energy technologies in current hydrocarbon export markets
- Small, innovative businesses, entrepreneurs and talent leave Alberta due to lack of access to market and capital (unlike in, e.g., Silicon Valley)
- Environmental protection regulations locally and globally hindering current resource extraction practices

Building on consensus: prior work related to innovation in Alberta

In a variety of ways, the problems posed and solutions proposed here are not completely new. Many people and organizations in Alberta and elsewhere have confronted similar issues and have come to similar conclusions. For the province, there are many reports and prior policy developments that have led to, and provide insights into, the Alberta innovation system as it is today, and we acknowledge their important contributions.

The Alberta innovation system had its most recent turning point in 2010 with the creation of Alberta Innovates corporations through the signing of the *Alberta Research and Innovation Act*. Unfortunately, the value proposition for the Alberta Innovates system consolidation and alignment was never fully realized. In early 2013, a report by *University Ventures International* pointed to the stalled evolution of the Alberta innovation system and the readiness of the province to move forward. The report underscored the need for a holistic, systemic solution, and highlighted some of the deficiencies within the current system, including a lack of coordination, central oversight, and long-term strategic vision. This stalled evolution is all the more regrettable since many of Alberta's future and development prospects hinge upon it. The Emerson Report, published in 2011 by the Premier's Council for Economic Strategy, highlighted Alberta's long-term vision and core themes for economic development, most of which relate to science, technology, and innovation. The report specifically proposed a two-fold institutional strategy around a Global Centre for Energy and an Alberta Institute for Advanced Technology. However, the report assumed that the restructuring of the system under Alberta Innovates would be completed, envisioning the Global Centre for Energy as the home for a big AOSTRA-type initiative and AIAT as part of a diversification push. The recommendations made in this report, when implemented, will breathe new life into these important outcomes of the Emerson Report as new entities will be established to make organizations such as the Global Centre for Energy and an Alberta Institute for Advanced Technology feasible.

The following summarizes the reports reviewed as background for this study, and from which many of our conclusions and recommendations derive. The broad consensus among these expert reports and the tremendous work that led up to the current study give us confidence that our recommendations are neither disconnected from, nor will be a shock to, the existing institutions and their ongoing activities. Rather, they are a natural part of a decade-long system evolution and underscore that the time to take the next steps is now.

- In 2010, the Alberta Competitiveness Council released the *Report on Competitiveness: Alberta 2010*, which benchmarked Alberta's performance against fourteen other countries and regions. The report measured Alberta's position on sixty indicators across the entire provincial economy, and found that Alberta ranks well in terms of prosperity, particularly GDP per capita, and environmental and social measures of well-being, such as equality of income distribution and risks of poverty and illness. The report also identified a number of priority areas throughout the entire economy requiring urgent government and industry attention; these included productivity, innovation, business sector foreign investment, and venture capital investment. These findings underscore the issues and suggestions described in the present report.
- The 2011 report *Shaping Alberta's Future* (Emerson Report), published by the Premier's Council for Economic Strategy, posed the challenge of a long-term horizon for the province in its socioeconomic thinking. The report

translated the question “What will the world be like in 2040?” into a pressing “Call for Action for all Albertans.” It observed that “Alberta has recognized the need to broaden the province’s economic base for six decades, and yet success remains elusive.” Further, the report points to “increasing recognition that nurturing an innovation-based economy requires an innovation ‘ecosystem,’ in which multiple elements work together to create conditions in which businesses of all sizes have the best opportunity to thrive.” It underscores the need for “flagship initiatives that ... have the potential to radically transform the Alberta economy, putting it on a trajectory that will secure future prosperity....” As do our recommendations, the report exhorts Alberta to “begin now, in a big way, putting sufficient muscle behind the institute to build momentum for innovation.” The report highlighted five themes: realizing the full potential of Alberta’s energy resources; broadening Alberta’s economic base; preparing Alberta to prosper in a global economy; providing a strong platform to sustain Alberta’s economic growth; and investing in shaping Alberta’s future. As already discussed, the report proposed a two-fold institutional strategy around a Global Centre for Energy and an Alberta Institute for Advanced Technology under the assumption that the restructuring of the system under Alberta Innovates would be completed, allowing these institutions to thrive.

- *Innovation Canada: A Call to Action* (often referred to as the Jenkins Report), was released by the Independent Panel on Federal Support to Research and Development in 2011. The report identified opportunities for increasing Canada’s business innovation through more effective resource utilization, thereby improving global competitiveness. The panel concluded that rationalization of Canada’s RDI programs is required to increase scale, reduce duplication, improve delivery efficiency, and create much greater awareness among the business sector. Six specific recommendations were made, each consistent with the findings of this report regarding the essential nature of stimulating provincial business innovation through structural and policy vehicles. The report specifically argued for a “whole-of-government” approach across a variety of domains - which speaks directly to how innovation policy is different than science policy. It underscored that “the responsibility to foster innovation cuts across many functions of government and requires a system-wide perspective. For this reason, the government needs to establish business innovation as a whole-of-government priority. This will require the designation of a minister as the voice for innovation, with a stated mandate to put innovation at the centre of the government’s economic strategy and to engage the provinces in a dialogue on innovation to improve coordination and impact ...” The report proposed “that the government’s main tool in that regard should be an external Innovation Advisory Committee (IAC) - a body with a whole-of-government focus that would oversee the realization of our proposed action plan, as well as serve as a permanent mechanism to promote the refinement and improvement of the government’s business innovation programs going forward,” as well as “a new, whole-of-government program delivery vehicle - the Industrial Research and Innovation Council (IRIC) - that would be the centrepiece of the federal government’s efforts to help entrepreneurs bring their innovative ideas to the marketplace and grow their companies into internationally successful businesses.”
- The 2012 *Alberta Research & Innovation Plan* (ARIP 2012) reflects the role of research and innovation in advancing the Government of Alberta’s (GoA) vision for social, environmental, and economic sustainability as outlined in the 2013-16 *Government of Alberta Strategic Plan*. ARIP 2012 discusses the Alberta research and innovation system’s key outcomes and themes as they align with the GoA vision and near-term strategy. Specific GoA directions are stated as (1) Advancing World Leading Resource Stewardship; (2) Securing Alberta’s Economic Future; and (3) Investing in Families and Communities. These directives are translated into key outcomes: (1) Effective Resource and Environmental Management; (2) Broadened Economic Base; and (3) Resilient and Healthy Communities.

- The recent 2013 *Paradox Lost Report* by the Council of Canadian Academies points to Canada's overall weakness in innovation, which stands in contrast to its undeniable research strengths. This paradox is attributed to the comfortable niche character of Canadian industries exporting to the U.S. market and the lack of incentives to increase multi-factor productivity. The report argues that this apparent paradox "is resolved once it is recognized that (i) most innovation does not work according to a 'linear' model in which academic research yields a pipeline filled with ideas that, following some research and development (R&D), are commercialized by business; and (ii) business strategy in Canada is powerfully influenced by many factors besides those that motivate innovation." Further, "this structural condition accounts for many of the issues that continue to confound the innovation policy dialogue in Canada, e.g. ... the particular difficulty of connecting university research with business. These are demand-side problems for which supply-side solutions continue to be proposed. Unless and until highly R&D-intensive firms achieve much greater weight in Canada's economy, a shortage of receptors to further develop early stage concepts and technologies will continue to frustrate supply-push policies." The path forward, then, is a more systemic approach to innovation. The *Paradox Lost Report* is thus broadly in line with the recommendations of the present report.
- A recent working paper by the Alberta Research and Innovation Authority (ARIA) discussed the opportunity for system-wide transformation represented by the Institute initiative. It proposed an umbrella-type, arm's-length organization with significant budget authority that has the potential to form a new centre of gravity for innovation in the province. The report laid out well the specific historical circumstances that have led to the current system and its challenges, and pointed to a number of specific shortcomings in it (e.g., the limited success of ARIC and PAC). It underscored that "the innovation system in Alberta is not broken. However, ... the system can be improved to support the government's desired economic growth and diversification outcomes."
- In parallel, many Campus Alberta institutions have moved forward and developed strategic plans in response to a call by the government, articulating their research strengths and priorities as well as visions and ambitions for their future. For the University of Alberta and University of Calgary in particular, innovation and internationalization feature high on the agenda, and a number of initiatives have been launched that are broadly synergistic with the recommendations of this report - above all the increased role of the innovation service providers of TEC Edmonton and Innovate Calgary.

Many other reports with more specific focus, on sectors and otherwise, include (but are not limited to):

- Alberta Livestock and Meat Strategy
- Alberta Nanotechnology Strategy
- Alberta's 2008 Climate Change Strategy
- Alberta's Action Plan: Bringing Technology to Market
- Alberta's Health Research and Innovation Strategy
- Getting Value from Every Fibre: Making the Most of Alberta's Lignocellulose Resource
- Land-use Framework
- Launching Alberta's Energy Future: Provincial Energy Strategy
- Making the Food-Health Connection, An Alberta Framework for Innovation
- Responsible Actions: A Plan for Alberta's Oil Sands
- Water for Life, A Renewal

International Innovation Systems Review (Selection)

Many countries and regions throughout the world offer examples of successful innovation systems and transition strategies. Several of them are, for various reasons, relevant to Alberta. Drawing upon the broad international experience represented in the Expert Panel, we reviewed innovation strategies from many jurisdictions and established several criteria for considering a given jurisdiction as relevant to Alberta:

- Operation within an economy that shares important characteristics with Alberta, including size, existence of resource-based industries, level of maturity of key institutions, similar trajectory of the innovation system, and the need for purposeful innovation system redesign at some point;
- Local business culture (including laws, governance, regulations) with relevance to that of Alberta;
- Universities and other research organizations that approximate those of Alberta in terms of size, research competitiveness, historical role, attitudes towards industry, and demonstrated ability to contribute to economic development; and
- Sociopolitical culture and climate sufficiently similar to that of Alberta.

We found three of the Nordic countries of Europe - Norway, Denmark, Finland - as well as Australia and New Zealand to be particularly relevant for Alberta. The Nordic countries share characteristics with Alberta in terms of size, climate, and (in part) natural resource strengths. They are also commonly seen as innovation leaders and best practice examples for their strong, democratic institutions, resource stewardship, and social inclusion. Likewise, Australia and New Zealand are natural resource economies that in recent years have focused on strengthening their innovation systems. They further share geographic and population characteristics with Alberta, socioeconomic and institutional histories as Commonwealth Nations, and a desire for stronger innovation, particularly in their business sectors.

Other countries generally seen as innovation leaders are more dissimilar to Alberta in terms of geography, size, economic structure, and political culture. These countries include Singapore, Israel, the United States and Germany. Nevertheless, they provide important insights regarding transition strategies, mission-oriented research, university reforms, and/or funding initiatives for entrepreneurship or high-risk business research, which is why we reviewed them for insights that may translate to the Alberta context. For example, Israel's innovation system was assessed because of the country's high level of entrepreneurship for its relatively small population, which is also a defining characteristic of Alberta.

Finally, Canada's national innovation system was reviewed to provide critical context for considerations of Alberta's innovation system.

This initial review of international innovation systems is based on the extensive specific experience of Expert Panel members with some of these systems, OECD publications, ERAWATCH²⁷ information, research publications, and various other publicly available sources.

²⁷ ERAWATCH is the European Commission's information platform for the European Research Area (ERA) on transnational, national, and regional research and innovation systems and policies.

This review supports the findings of the Expert Panel presented in the main body of this report. It makes clear that Alberta has an opportunity to develop a robust and world-class innovation system grounded in the province's unique strengths and consistent with national objectives as well as international best practice. Alberta's initiative to develop a more innovative economy with international scope and particular focus on business innovation also reflects similar objectives for the broader Canadian innovation system. However, as we emphasize in the report, it is essential to acknowledge the differences in the domestic environments of the reviewed countries. Alberta can learn from these countries, but we caution against the assumption that one country's efforts can be translated directly into the innovation strategy of another country or region.

The review provides several key lessons concerning the context of innovation systems and these lessons are reflected in the report and our recommendations. First, global economies that have successfully pursued industry-oriented innovation typically are guided by an influential council that advises the government leadership on innovation policy and strategy. For example, Finland and Singapore have high-level innovation councils chaired by highly placed government officials to ensure the required top-level involvement and horizontal coordination, communication with innovation stakeholders from across the jurisdiction, and effective and efficient implementation of necessary modifications to the existing innovation system. Very recently an expert panel has recommended New Zealand form such a council as it undertakes significant innovation system reforms.

Second, international experiences confirm that Alberta requires a strong central management body as part of a robust innovation system. We reviewed several potentially relevant models for innovation implementation bodies from other economies, including the Agency for Science, Technology and Research (A*STAR) in Singapore and TEKES in Finland.

Again, one needs to note the limitations of such benchmarking efforts. For example, while Singapore's A*STAR has been successful at creating world-class research institutes in both the physical and biological sciences, it has failed to create an innovative culture in the country. Singapore has few startups and little auxiliary economic development arising from the A*STAR Institutes. Most economic development via A*STAR has been in bio-manufacturing, with R&D-type industries attracted to Singapore by significant tax incentives and cheap land. Singapore's success is thus due to its parallel emphasis on investing and trading and the links it provides between markets, and not on innovation through research and entrepreneurship per se. This underscores the need for a broader, systemic perspective on innovation. Likewise, TEKES, the main Finnish public funding organization for research, development, and innovation, is undergoing significant restructuring, as the Finnish economy is struggling and requires a refreshed approach to how government influences and supports industry. The small Scandinavian country faces significant challenges not unlike those in Alberta: the demise of the former flagship industry - ICT and microelectronics - is ongoing, and opportunities to upgrade domestic natural resource sectors (particularly forestry and pulp) through R&D to higher value-added levels as a result of the ICT boom have been missed.

Third, the experiences of most countries we reviewed confirms that both "top-down" and "bottom-up" approaches are needed to stimulate industrial innovation and further develop entrepreneurial capability. This is no less the case for Alberta. As recommended for Alberta, high-level government support, long-term vision and a move towards system efficiency are critical. Existing economic strengths and mature industries are advantages to acknowledge and expand. At the same time, innovation ambitions must be fed with diverse basic and applied research and

entrepreneurial activity and formation of new industries must be encouraged. Moreover, small companies need to gain access to venture financing and international markets to grow and meaningfully contribute to an economy. Israel, although very different in context from Alberta, shares this characteristic with the province, and exemplifies a country that has laid innovation system foundations that have yielded a very innovative small business sector with strong integration into the international market.

The remainder of this appendix provides a brief synopsis of how the innovation system structures of some key reference jurisdictions for Alberta are constituted.

Australia

	Australia	Alberta
Population	23.3 million ⁽¹⁾	4.0 million ⁽¹⁾
Population density³	3.0/km ² ⁽¹⁾	5.7/km ² ⁽¹⁾
Major export sectors	Natural resources (coal, iron copper, gold, natural gas, petroleum), energy, food and agriculture, machinery and transport equipment, medical devices	Mining, energy, petroleum products and petrochemicals and plastic, food and agriculture, wood, machinery
R&D intensity (GERD/GDP)	2.2% ⁽²⁾	1.2% ⁽³⁾
Share of private sector R&D	62% ⁽²⁾	51% ⁽³⁾
Triadic patents per million people per year	10.0 ⁽²⁾	10.3 ⁽⁴⁾

⁽¹⁾ 2013 data

⁽²⁾ 2011 data or latest available year (OECD data)

⁽³⁾ 2009 data

⁽⁴⁾ 2007 data

All major Australian policy decisions are, in principle, made at Cabinet level. The Government is informed by the Prime Minister's Science, Engineering and Innovation Council (PMSEIC).

The main research and innovation coordination bodies are:

- Innovation Australia, an independent statutory body established in 2007 to assist with the administration of the Australian Government's innovation and venture capital programs designed to support industry innovation. Innovation Australia, like other Industry Advisory Councils in Australia, reports to the Minister for Industry and Innovation to provide innovation advice.
- The Australian Research Committee (ARCom), formed in 2012 based on a recommendation of the 2011 Focusing Australia's Publicly Funded Research Review. It provides integrated and strategic advice to the government on investment across the science, research, and innovation system, including in the areas of human capital, infrastructure, and collaborative activities. ARCom developed the 2012 National Research Investment Plan as a whole-of-government framework against which future research funding decisions can be taken. ARCom is chaired by the Chief Scientist and includes senior officials from Commonwealth departments, the Heads of the ARC, NHMRC, CSIRO and DSTO, and a senior representative from Universities Australia.
- The Commonwealth States and Territories Advisory Council on Innovation (CSTACI) which provides coordination between the Commonwealth and State governments.
- The Coordination Committee on Innovation (CCI), which includes representatives of all government departments and agencies that fund or perform research and facilitates exchange of information, coordination, and strategic planning.
- The Chief Scientist, who advises the government on major scientific issues.

The Department of Innovation, Industry, Science and Research (DIISRTE) is the key Australian department in research policy and funding. The Department assists the Minister in managing a portfolio that includes the Commonwealth Scientific and Industrial Research Organization (CSIRO), the Australian Research Council (ARC), the Cooperative Research Centre (CRC) Program, Australian Nuclear Science and Technology Organization (ANSTO), Australian Institute of Marine Science (AIMS), and Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS). Other departments with significant research policy and management roles are: Department of Health and Ageing, which administers the National Health and Medical Research Council (NHMRC); Department of Defence, which includes the Defence Science and Technology Organization (DSTO); Department of Agriculture, Fisheries and Forestry, which includes the Bureau of Rural Sciences and the Rural Research Councils; and the Department of Resources and Energy, which includes Geoscience Australia.

In addition to direct departmental funding of their own research agencies and general university funding, there are two major direct research-funding bodies:

- The Australian Research Council (ARC), which provides competitive funding for university researchers in all fields except medicine; and
- The National Health and Medical Research Council (NHMRC), which provides competitive funding in medical fields.
- In addition, CSIRO provides limited funds through its Flagship Collaboration Fund.

Over the past 15 years, the major growth in research activity has been in universities, through major funding increases to the research councils, and in industry. As a result, the role of government research organizations has declined in relative terms. The main public sector research performers are:

- Commonwealth Scientific and Industrial Research Organization (CSIRO)
- Australian Nuclear Science and Technology Organization (ANSTO)
- Australian Institute of Marine Science (AIMS)
- GeoScience Australia (GA),
- Rural Industry R&D Corporations (RIRDCs)
- Cooperative Research Centres (CRCs)
- Defence Science and Technology Organization (DSTO)
- National Measurement Institute (NMI)
- The 39 Universities Australia members

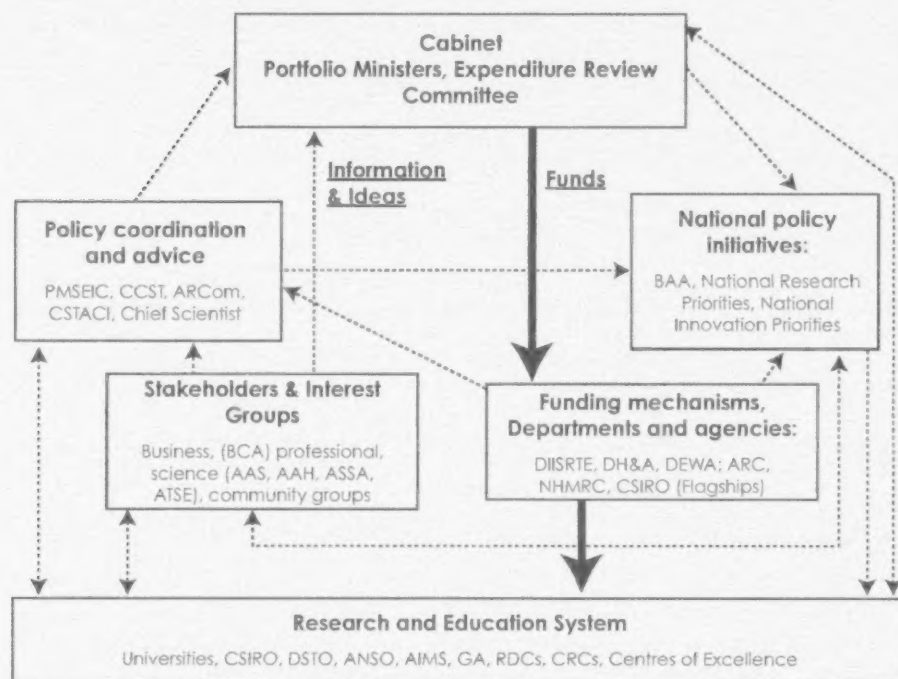
Two institutions closely considered for the purposes of this report are:

- **Innovation Australia (previously Industry R&D Board).** Established as the IR&D board many years ago, this statutory authority has had measurable success and as a consequence is supported throughout the Australian political spectrum. Its powers include the requirement to design, implement, and manage programs involving innovation according to government-established policy and priorities. It has assisted with the emergence of biotechnology, agriculture, mining technologies, and new energy industries in the past 10 years,

Appendix 5 – Australia

as well as providing leverage for the venture capital industry and cluster creation with the various States of Australia. All its programs have been evaluated upon completion to have had good degrees of success. It also provides strategic advice to government and acts as a focus for the innovation system in Australia. It is managed by industry and works closely with a government agency, AusIndustry, to deliver and monitor the programs.

- **BioInnovation SA**, a provincial organization based in South Australia that exists to stimulate the growth of the bio-economic industries. It has government funding, is a statutory authority, and has powers to design, invest in, and manage industry programs. These include diverse activities such as venture capital, research parks and incubators, product development programs, and international access programs. BioSA has been thoroughly reviewed and the South Australian bio-economy (on a per capita basis) has been found to outperform similar regions in Australia and the world.



Australia's Innovation System⁷⁸

⁷⁸ Don Scott-Kemmis, ERAWATCH Country Reports 2012: Australia, ERAWATCH Network, 2012.

Denmark

	Denmark	Alberta
Population	5.6 million ⁽¹⁾	4.0 million ⁽¹⁾
Population density ³	3.0/km ² ⁽¹⁾	5.7/km ² ⁽¹⁾
Major export sectors	Machinery and instruments, meat and meat products, dairy products, fish, pharmaceuticals, furniture	Mining, energy, petroleum products and petrochemicals and plastic, food and agriculture, wood, machinery
R&D intensity (GERD/GDP)	3.1% ⁽²⁾	1.2% ⁽³⁾
Share of private sector R&D	60% ⁽²⁾	51% ⁽³⁾
Triadic patents per million people per year	41.1 ⁽²⁾	10.3 ⁽⁴⁾

⁽¹⁾ 2013 data

⁽²⁾ 2011 data or latest available year (OECD data)

⁽³⁾ 2009 data

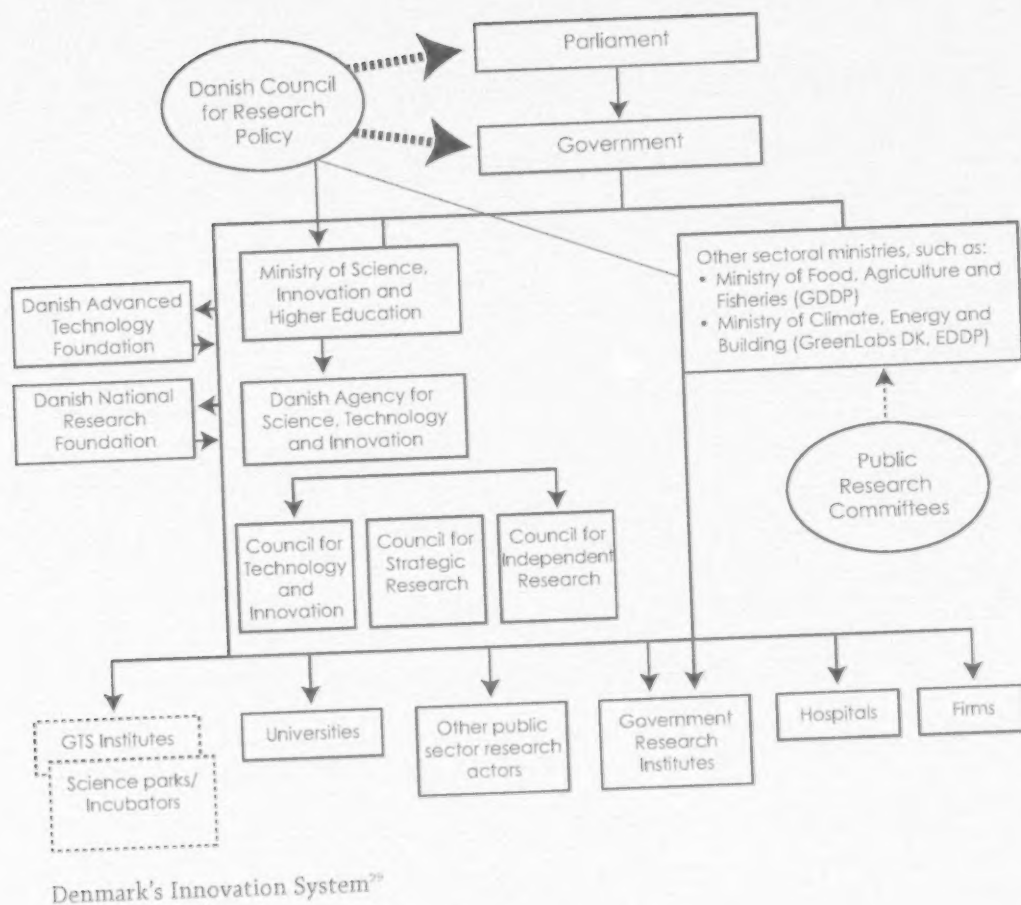
⁽⁴⁾ 2007 data

Denmark has a well-established innovation system and spent 3.1% of GDP on R&D in 2012. Denmark's innovation system is governed by the parliament and the government. The main body in the governance system is the Ministry of Science, Innovation and Higher Education (former Ministry of Science, Technology and Innovation), which coordinates all research and innovation policies and most of the funding. The Danish Agency for Science, Technology and Innovation functions at the operational level. At the agency level, the three most important institutions are the Danish Council for Independent Research, which takes care of researcher-initiated "curiosity-driven" research; the Danish Council for Strategic Research, which is responsible for targeted research based on policy initiatives; and the Council for Technology and Innovation, which advises the Minister of Science, Innovation and Higher Education on technology and innovation policy and administers related initiatives.

There are also separate foundations for basic science: The Danish National Research Foundation and The Danish National Advanced Technology Foundation. Neither is an agency as such. Both foundations are independent, although established by government acts; their capital is provided by the Danish government.

The main actors doing research are the eight universities, government research institutes (i.e., the ministry-owned sectorial research institutes and the independent Approved Technological Service Institutes - GTS institutes), in addition to R&D in companies.

Appendix 5 – Denmark



²⁹ http://erawatch.jrc.ec.europa.eu/erawatch/opencms/information/country_pages/dk/country?section=Overview&subsection=StrResearchSystem

Finland

	Finland	Alberta
Population	5.4 million ⁽¹⁾	4.0 million ⁽¹⁾
Population density³	17.9/km ² ⁽¹⁾	5.7/km ² ⁽¹⁾
Major export sectors	Electronic and optical equipment (including telecommunications), machinery, transport equipment, paper and pulp, chemicals, basic metals; timber	Mining, energy, petroleum products and petrochemicals and plastic, food and agriculture, wood, machinery
R&D intensity (GERD/GDP)	3.8% ⁽²⁾	1.2% ⁽³⁾
Share of private sector R&D	67% ⁽²⁾	51% ⁽³⁾
Triadic patents per million people per year	51.9 ⁽²⁾	10.3 ⁽⁴⁾

⁽¹⁾ 2013 data

⁽²⁾ 2011 data or latest available year (OECD data)

⁽³⁾ 2009 data

⁽⁴⁾ 2007 data

Finland ranks second in the OECD in R&D investment (4.08% of GDP in 2011). Most business R&D investment is in electronics. Traditional industries (wood and metal) account for less than 20%. According to the OECD, the country has very few R&D-oriented startups, partly owing to a lack of risk capital.³⁰

The Finnish Science Policy released in 2009 included plans and mechanisms to encourage growth and business innovation. These included an increase in R&D investment to 4.0% of GDP.

Innovation in Finland is governed at the highest level by the Finnish Research and Innovation Council, which is chaired by the Prime Minister and advises ministries. Science policy is carried out by the Ministry of Education (education and science policy) and the Ministry of Employment and the Economy (industrial and technology policy). Funding is distributed through the Academy of Finland, TEKES (the main Finnish public funding organization for research, development and innovation), and Sitra (the Finnish Innovation Fund).

Finland is currently revamping its science and education system; under development are incentives for higher education institutions to engage in collaboration with companies, an R&D tax incentive scheme for companies, revised regulatory frameworks and steering systems to support the exploitation of research and innovation activities and experiments, funding and steering of education, research and innovation activities to support internationalization, international evaluations of TEKES and the Academy of Finland, as well as those of Strategic Centres of Excellence in science, technology and innovation (SHOKs).

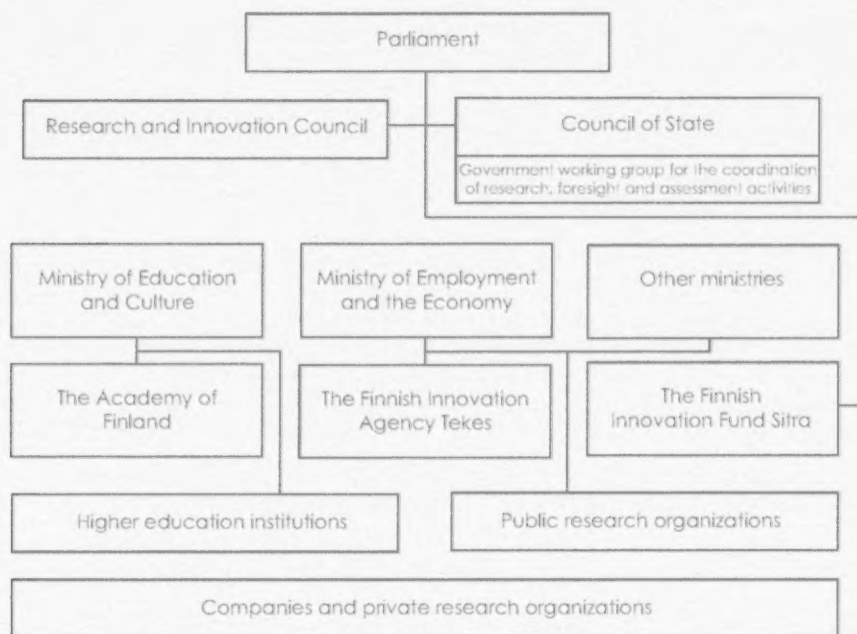
³⁰ Organization for Economic Cooperation and Development: *OECD Science, Technology and Industry Outlook 2008, Science and Innovation: Country Notes: Finland*, ISBN 978-92-64-04991-8.

Appendix 5 – Finland

Finland has set an objective to maintain the R&D funding share of GDP at nearly 4%, with public investment at approximately 1.2% of GDP. The priority areas for innovation funding include maintaining competitiveness and innovation in areas of strength in business and industry, and the promotion of bottom-up, organic innovation.

Finland's SHOKs were established a decade ago through TEKES funding and are public-private partnerships tasked with accelerating the innovation processes and boosting private sector-initiated research done in partnership with publicly funded research. There are six centres, based around particular areas of industry strengths:

- forestry
- information and communication industry and services
- metal products and mechanical engineering
- energy and the environment
- built environment innovations
- health and wellbeing



Finland's Innovation System²¹

TEKES of Finland was closely considered for the purposes of the report. It is a government body that has had considerable resources and authority to invest in innovation in Finland. Part of the success of the emergence of its economy post the Cold War has undoubtedly been due to TEKES. The key aspects to extract for the TEKES model

²¹ Totti Könnölä, ERAWATCH Country Reports 2012: Finland, ERAWATCH Network, 2012.

Israel

	Israel	Alberta
Population	8.1 million ⁽¹⁾	4.0 million ⁽¹⁾
Population density³	367/km ² ⁽¹⁾	5.7/km ² ⁽¹⁾
Major export sectors	Machinery and equipment, software, cut diamonds, agricultural products, chemicals, textiles and apparel	Mining, energy, petroleum products and petrochemicals and plastic, food and agriculture, wood, machinery
R&D intensity (GERD/GDP)	4.4% ⁽²⁾	1.2% ⁽³⁾
Share of private sector R&D	40% ⁽²⁾	51% ⁽³⁾
Triadic patents per million people per year	36.3 ⁽²⁾	10.3 ⁽⁴⁾

⁽¹⁾ 2013 data

⁽²⁾ 2011 data or latest available year (OECD data)

⁽³⁾ 2009 data

⁽⁴⁾ 2007 data

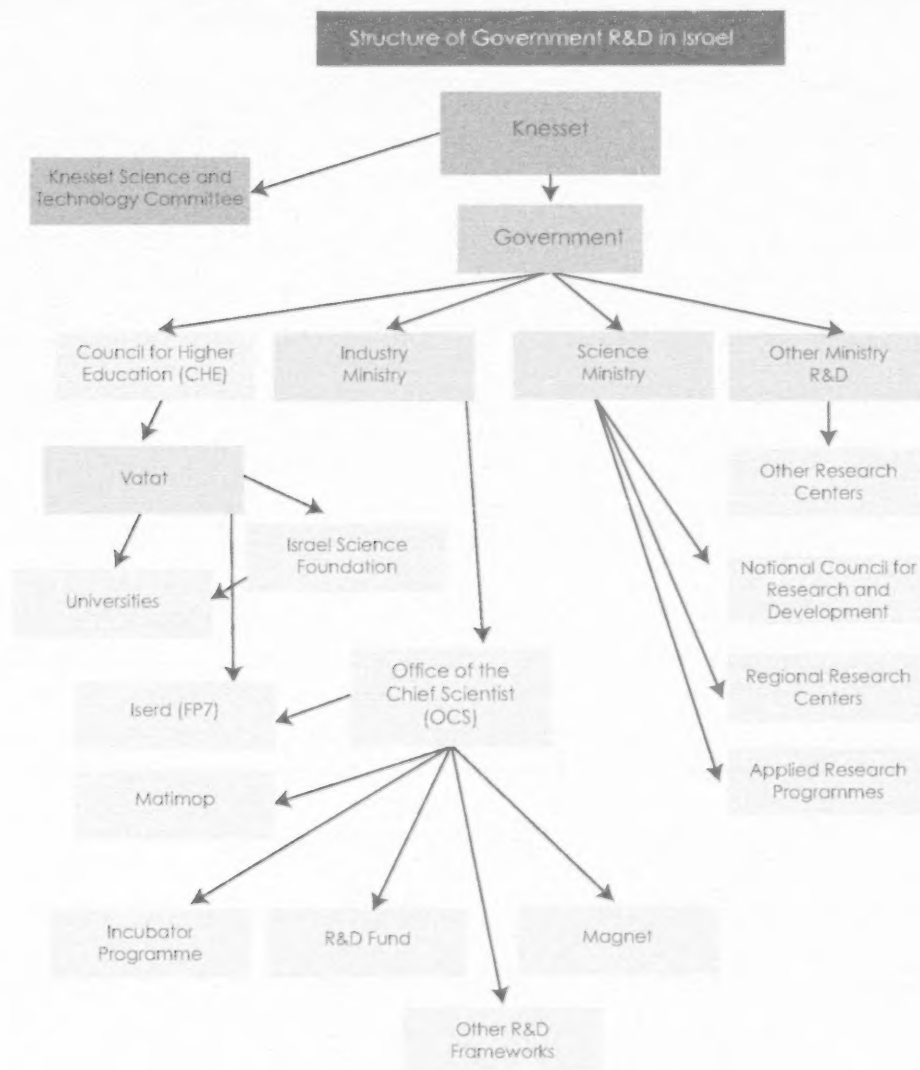
Israel is a small country with a population of 7.9 million as of January 2013. Research is an extremely high priority, with a total R&D expenditure reaching 4.4% in 2011. The private sector is a predominant player in research, providing 80.2% of all funds in 2011. The Knesset, Israel's parliament, determines the laws that govern research and development and approves the budgets for this activity. The Knesset Science and Technology Committee deals with policy on civilian R&D, advanced technologies, environmental R&D, academic scientific research, non-academic scientific research, research institutes, chief scientists in government offices, National Council of R&D, research foundations, and information/computer technology, but plays no part in the budgeting process for these activities. The main recipients of these budgets are the Council for Higher Education's (CHE) Planning and Budgeting Committee (Vatat), The Ministry for Industry, Trade and Employment, the Science and Technology Ministry, and some ministries such as the Ministry of Agriculture, which has a fairly significant budget for its own research projects. In some cases, the Ministry of Finance (Treasury) takes a part in directly financing projects that are perceived as being of high national importance.

At the executive level of activity, the two predominant entities are Vatat and the Office of the Chief Scientist (OCS). The former distributes funds to universities through a block funding mechanism that awards a certain proportion of funds to research, and to local and international competitive research frameworks. The OCS operates a broad framework of activities: the R&D Fund, which directly funds R&D in companies in return for future royalties; the Magnet program, which encourages research-university collaboration in consortia; the Incubator Program; and the FP7 bureau, Matimop, which is in charge of international activities and other programs.

Much of Israel's innovation has been catalyzed by challenging environmental pressures. Just sixty years ago, Israel was a new country with very little land and cut off from the food sources of neighbouring countries. Therefore, one of Israel's first goals was to grow enough food to feed the population. Because of the acute shortage of land and

Appendix 5 – Israel

fresh water, agriculture needed to be very efficient, and as a result the Israelis developed highly sophisticated and innovative agricultural systems. Today, the country produces almost all of its own food, although it does not grow wheat or rice and imports produce that is more competitively grown elsewhere.



Israel's Innovation System⁹²

⁹² Abraham Garcia, ERAWATCH Country Reports 2012: Israel, ERAWATCH Network, 2012.

An independent national research institute for agriculture was established and, within it, researchers were given the freedom to conduct basic, applied, and product-oriented research. Research on genetic modification, for example, is funded by the government, with the results distributed directly to farmers. However, the intellectual property generated by these researchers is not protected, thus reducing its potential commercial value. The institute developed a mentoring program where institute researchers take the farmers need and deliver it at no cost to the farmers. The Agricultural Research Organization is administratively part of the Ministry of Agriculture.

Other government research institutes have been established in areas including geology, geophysics, oceanography and health (specifically social and public health, health systems, and preventative medicine and genetic syndromes).

All other research is conducted in universities and at private R&D companies and organizations.

Israel's universities provide education and research in many domains. Basic research is a core focus, with no government mandate for prioritization of topics. Israeli researchers have very strong connections with researchers in other countries, which includes individual research collaboration funded by binational endowments.

Israel's innovation system evolution is not government driven but rather organic, having grown through the support of past government investment in the education system and in defence R&D. Substantial government investment in defence R&D (electro-optic, cryptography, computer vision, applied mathematics, and so on) has led to many follow-on civilian applications with multiple technology-based startup companies created each year.

A number of factors facilitated the development of Israel into the innovative nation it is today:

- High-quality universities. There are research universities in Israel that are very competitive and the system is well-connected internationally. The higher education system is open: anyone who wants to attend can do so. Tuition is set at a reasonably low rate and fellowships are available for low-income students.
- Significant investment in public domain research and a high regard for innovation.
- A military system that produces innovative thinkers with commercial ideas. The Israel Defense Force is a key place for networking and skill building among young and talented entrepreneurial thinkers.
- Innovation initiatives such as pre-seed funds and "incubators" where startups learn about R&D, business, marketing, doing business worldwide, and so on.
- Multinationals (for example, Digital, IBM, Intel, Microsoft, and Google) have established R&D centres in Israel.

New Zealand

	New Zealand	Alberta
Population	4.5 million ⁽¹⁾	4.0 million ⁽¹⁾
Population density³	16.6/km ² ⁽¹⁾	5.7/km ² ⁽¹⁾
Major export sectors	Dairy products, meat, wood and wood products, fish, machinery	Mining, energy, petroleum products and petrochemicals and plastic, food and agriculture, wood, machinery
R&D intensity (GERD/GDP)	1.3% ⁽²⁾	1.2% ⁽³⁾
Share of private sector R&D	40% ⁽²⁾	51% ⁽³⁾
Triadic patents per million people per year	9.3 ⁽²⁾	10.3 ⁽⁴⁾

⁽¹⁾ 2013 data

⁽²⁾ 2011 data or latest available year (OECD data)

⁽³⁾ 2009 data

⁽⁴⁾ 2007 data

New Zealand's research and innovation system is highly dependent on the public sector for both funding and performing research. However, the entire New Zealand R&D system has undergone a significant shift over the last 15 years. While it tended to be primarily science-driven, it gradually has turned much more market-driven and focuses on contributing to creating economic growth and solving some major societal challenges.

New Zealand's gross expenditure on research and development (GERD) as a proportion of gross domestic product (GDP) has steadily increased from 1.15% in 2002 to 1.31% in 2010. This is in line with the Government's strategy. The private sector R&D expenditure (BERD) was 0.54% of GDP in 2010, up from 0.42% in 2002. The private sector performed 41% of all R&D in 2010.

The various Crown agencies and Ministries that comprise the New Zealand Government are funded through a series of packages called "Votes," each of which is made up of a number of output expenses. The funding for each output expense is specified in the budget each year. The New Zealand Government funds research through Vote research, science and technology (RS&T) and Vote Education.

The current research policy agenda for New Zealand was developed in the Ministry of Science, Research and Technology's discussion document *Igniting Potential: New Zealand's Science and Innovation Pathway*, released in 2010.

The government has highlighted the ambition to boost economic growth and revenue through long-term R&D investment. This involves various aspects, such as increased investment, changes to organizational formation, and specific focus areas. The government argues that for science and innovation to create growth opportunities, it is necessary to have a robust science and innovation system that is responsive to national needs and opportunities. The government is taking steps to improve New Zealand's system, empower the people working within it, and achieve better returns from public investment and direct government support where it can make the most difference.

Appendix 5 – New Zealand

An important new initiative has been to restructure government funding to clarify priorities and provide a more direct pathway for implementation. The priority outcome areas are:

- high-value manufacturing and services
- biological industries
- energy and minerals
- hazards and infrastructure
- environment
- health and society

The Crown Research Institutes (CRIs) occupy a central position within New Zealand's broader science and innovation system. The Government commissioned a task force to review the CRIs and has accepted its recommendations. As a result, all CRIs will receive a greater proportion of non-contestable funding, will become accountable for outcomes defined in a statement of core purpose, and will work more closely with the end users of their work and other stakeholders.

At the political level, the New Zealand government and its Science Advisory Committee are the main actors in setting the political agenda.

There have been significant changes at the operational level since 2008. The new government established in 2008 intended to implement a greater focus on the efficiency of the state sector. After the review of the Science and Innovation system in New Zealand, a series of recommendations were made and guided the central government to simplify and centralize the system and funding structures.

In June 2010, the Minister of State Services - upon reviewing the recommendations and the system as a whole - announced the creation of the new Ministry of Science and Innovation (MSI). The new Ministry was formed by merging the Foundation for Research, Science and Technology (FRST) and the Ministry of Research, Science and Technology (MoRST). The new Ministry was set to assume the responsibility for the policy and investment functions that were previously the purview of the two separate agencies. The entire process was aimed at supporting the government's vision for science and innovation to drive economic growth in New Zealand.

In 2012, Prime Minister John Key announced another major change - the creation of a new Ministry of Business, Innovation and Employment (MBIE), the result of the merger of four existing government departments (the Economic Development Ministry, Department of Labour, Science and Innovation Ministry and Department of Building and Housing).

The new ministry follows similar models set up in the United Kingdom (where a new Department for Business, Innovation and Skills was established in 2009) and Australia (where a new Department of Industry, Innovation, Science, Research and Tertiary Education was created in 2011). The new Ministry is designed to help drive the government's priority of building a more productive and competitive economy. It is also charged with strengthening the public service's ability to work on business policy, regulation and engagement to allow the government to achieve much more coordinated and focused resource allocation and management. The key overall goals in establishing the new ministry are to:

- Provide clear, coordinated and focused government policy leadership with a commitment to economic growth and innovation; and
- Reduce complexity for agencies working with each other and for businesses engaging with the government.

Appendix 5 – New Zealand

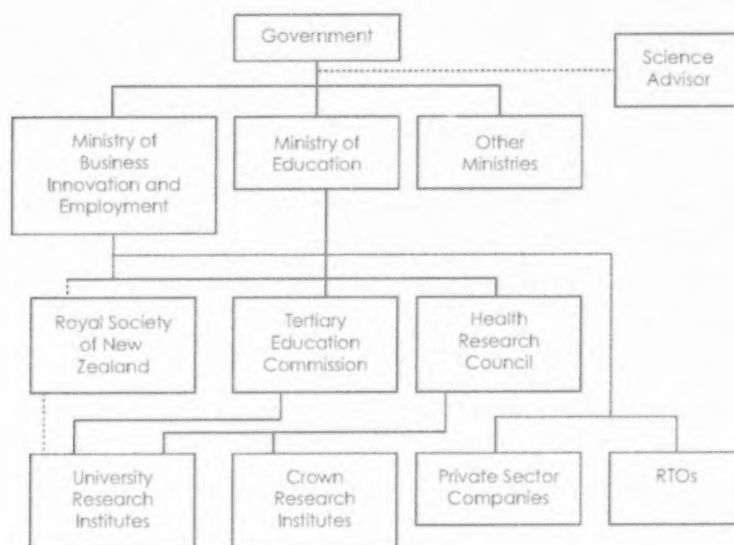
Legislation created during the short existence of the MSI established two boards - one focused on science and the other on innovation - in charge of making independent decisions on proposals for R&D funding. The government's view is that this provides a more balanced approach to funding processes. Each board is made up of highly qualified industry leaders with vast R&D experience.

In addition to the MBIE, two other institutions are responsible for research funding:

- The Health Research Council of New Zealand (HRC), the Crown agency responsible for the management of the Government's investment in public health research; and
- The independent national academy of sciences Royal Society of New Zealand (RSNZ). RSNZ represents some 60 scientific and technological societies and individual members and administers several funds for science.

In addition to the above, the government has put in place one of the main recommendations of the High Value Manufacturing and Services review report *Powering Innovation*.³³ The Report recommended the creation of an Advanced Technology Institute (ATI) to provide businesses with a single interface to the New Zealand innovation system, working in partnership with New Zealand Trade and Enterprise, economic development agencies, business incubators, universities, polytechnics, Crown Research Institutes, the venture capital community and industry associations.

One organization closely considered for the purposes of the report is **Callaghan Innovation**, established in early 2013 New Zealand by amalgamating the Industrial Research Laboratories (IRL, a Crown Research Institute) with additional and considerable financial resources. Its objective is to provide funding to support entrepreneurs and new industry growth, and to make available technical capabilities that might not exist in industry. It is too early to judge success, although the IRL was reviewed before amalgamation and judged a success in terms of applications of its R&D.



New Zealand's Innovation System³⁴

³³ J. Raine, et. al., "Powering Innovation: Improving access to and uptake of R&D in the high value manufacturing and services sector," An independent report commissioned by the New Zealand Ministry of Science and Innovation, 2011.

³⁴ Kenneth Husted, ERAWATCH Country Reports 2011: New Zealand, ERAWATCH Network, 2011.

Norway

	Norway	Alberta
Population	5.1 million ⁽¹⁾	4.0 million ⁽¹⁾
Population density³	15.6/km ² ⁽¹⁾	5.7/km ² ⁽¹⁾
Major export sectors	Petroleum and petroleum products, machinery and equipment, metals, chemicals, ships, fish	Mining, energy, petroleum products and petrochemicals and plastic, food and agriculture, wood, machinery
= R&D intensity (GERD/GDP)	1.7% ⁽²⁾	1.2% ⁽³⁾
Share of private sector R&D	44% ⁽²⁾	51% ⁽³⁾
Triadic patents per million people per year	20.2 ⁽²⁾	10.3 ⁽⁴⁾

⁽¹⁾ 2013 data

⁽²⁾ 2011 data or latest available year (OECD data)

⁽³⁾ 2009 data

⁽⁴⁾ 2007 data

The Norwegian innovation system has modest overall investment in R&D (1.7% of GDP in 2011). Much of the R&D in Norway is conducted by the public sector, and institutes play a key role as centres of applied R&D expertise. All R&D organizations in Norway compete for funding from the Norwegian Research Council, which is part of the Ministry of Knowledge.³⁵

Within the government, the Norwegian Ministry of Research and Education has the main responsibility for coordinating overall research policy and is the largest source of government research funds. Several other ministries have large research portfolios and each ministry is responsible for research related to its own sector in society. In addition to the Ministry of Research and Education, the main ministries funding research are the Ministry of Trade and Industry, the Ministry of Health and Care Services, the Ministry of Oil and Energy, Ministry of the Environment, the Ministry of Agriculture and Food, and the Ministry of Fisheries and Coastal Affairs.

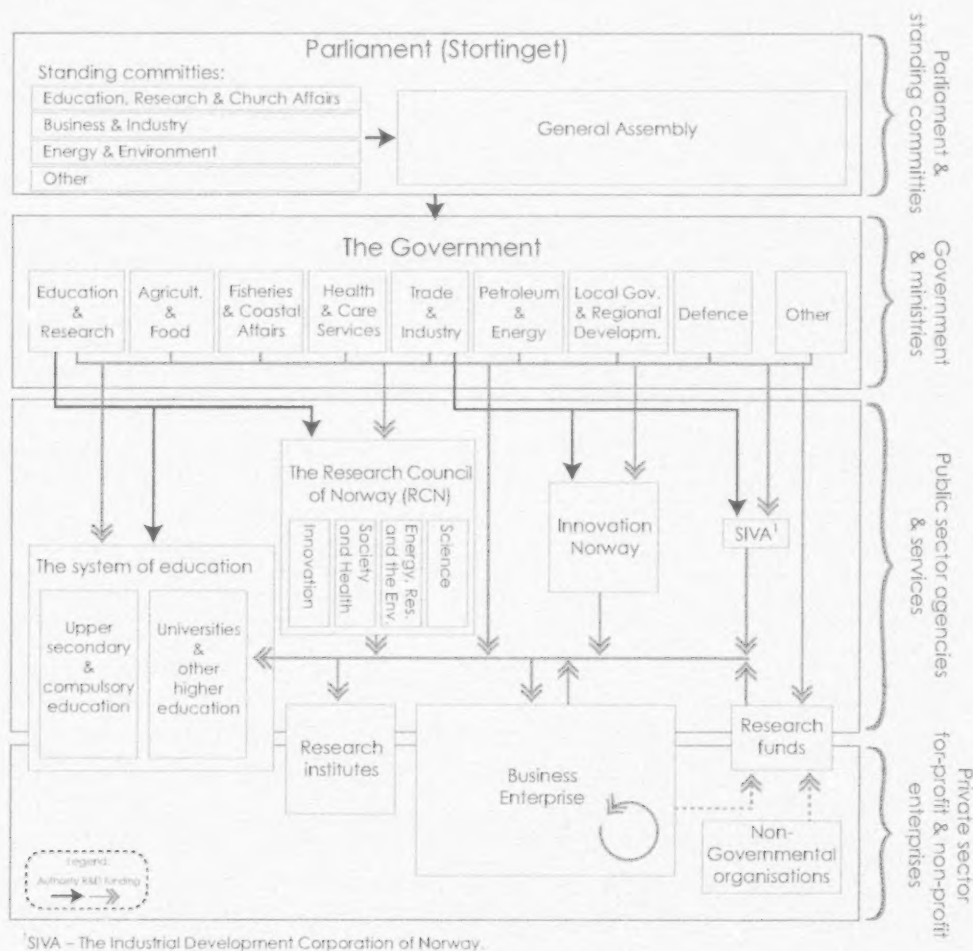
The Research Council of Norway (RCN) is the country's executive research policy agency. Its mandate is to establish and implement funding schemes for research, provide the government with research policy advice, and serve as a meeting place for researchers, research funders, and research users. RCN has five divisions: Science; Energy, Resources and the Environment; Society and Education; Innovation; and Administration. Following a reorganization in early 2011, the Innovation division now has a greater focus on research in and for industry and is tasked with integrating innovation with industry and technology.

The 2008 OECD Reviews of Innovation Policy identified that a main weakness of Norway's innovation system was its comparatively low level of R&D and innovation in some parts of the Norwegian business sector.³⁶ The report highlighted Norway's need to restructure towards more knowledge-intensive industries while building strength in existing ones.

³⁵ P. Morten, *The Role and Value of CRIÁ|Type Institutions Overseas*, The Hague, February 2008.

³⁶ Organization for Economic Coöperation and Development: *OECD Reviews of Innovation Policy: Norway*, OECD, 2008.

In 2009, the Norwegian Government stated that it aimed to increase R&D spending to 3% of GDP.²⁷ The government plan included encouraging business R&D through loans, grants and R&D tax credits, especially for SMEs. A number of programs are available to industry, including funding of R&D, tax deduction for costs related to R&D, industry employee advanced degree support, Research Centres including the Centres of Excellence (for long-term, high-quality basic research), Centres for Research-based Innovation (to establish or strengthen research groups working together); Centres for Environment-friendly Energy Research; and Centres of Expertise (for industry innovation on a regional context). These centres work collaboratively with companies, researchers, universities, and the public sector. The scheme is established in cooperation with Innovation Norway and SIVA (the Industrial Development Corporation of Norway).



Norway's Innovation System²⁸

²⁷ Norwegian Ministry of Education and Research: Climate for Research, 2009 (available at www.regjeringen.no/upload/KD/Vedlegg/Forskning/climate_for_research_final.pdf).

²⁸ Oxana Bulanova and Einar Lier Madsen, ERAWATCH Country Reports 2012: Norway, ERAWATCH Network, 2012.

Singapore

	Singapore	Alberta
Population	5.4 million ⁽¹⁾	4.0 million ⁽¹⁾
Population density ³	7669.0/km ² ⁽¹⁾	5.7/km ² ⁽¹⁾
Major export sectors	Machinery and equipment (including electronics and telecommunications), pharmaceuticals and other chemicals, refined petroleum products	Mining, energy, petroleum products and petrochemicals and plastic, food and agriculture, wood, machinery
R&D intensity (GERD/GDP)	2.2% ⁽²⁾	1.2% ⁽³⁾
Share of private sector R&D	55% ⁽²⁾	51% ⁽³⁾
Triadic patents per million people per year	14.3 ⁽²⁾	10.3 ⁽⁴⁾

⁽¹⁾ 2013 data

⁽²⁾ 2011 data or latest available year (OECD data)

⁽³⁾ 2009 data

⁽⁴⁾ 2007 data

Singapore has established a strong innovation system comprising public sector research institutions (A*STAR RIs), Institutes of Higher Learning (IHLs) including the universities, polytechnics, Research Centres of Excellence (RCEs) and international institutions under the Campus for Research Excellence and Technological Enterprise (CREATE), hospitals and academic medical centres, and corporate R&D laboratories. Singapore's autonomous universities have also been transformed to become more research-intensive. A holistic R&D framework and strategy was put in place to manage researchers and ensure the long-term relevance of Singapore R&D investments.

The Research, Innovation and Enterprise Council (RIEC) was established in 2006 to provide overall strategic direction for Singapore's R&D. The council, chaired by the Prime Minister, advises the Singapore Cabinet on national research and innovation policies and strategies.

The National Research Foundation (NRF) was formed under the Prime Minister's Office to support the RIEC in its work through the development and coordination of national policies to grow Singapore's R&D capabilities.

Key R&D agencies in Singapore, closely considered for the purposes of this report, are:

- The Agency for Science, Technology and Research (A*STAR), which comprises 21 public research institutes that conduct R&D with an industry focus, and is also involved in translating research outcomes into innovative products and services.
- SPRING, an agency under the Ministry of Trade and Industry that focuses on the translational aspects of R&D and the development of Small and Medium Enterprises
- The Economic Development Board (EDB), the lead government agency that works to attract multinational corporations and corporate R&D laboratories to Singapore.

Appendix 5 – Singapore

Under the Ministry of Education, there are the Institutes of Higher Learning, which include the Autonomous Universities (the National University of Singapore, the Nanyang Technological University, the Singapore Management University and the Singapore University of Technology and Design) and the polytechnics. There are also hospitals and academic medical centres under the Ministry of Health that engage in translational clinical research.

The National Research Foundation's programs and policies cover the entire innovation spectrum. The Ministry of Trade and Industry, with its various agencies, also covers the innovation range, although each agency would have a slightly different mandate. For example, A*STAR has 20 public research institutes that conduct R&D with an industry focus and is also involved in translating the research outcomes into innovative products and services. SPRING focuses more on the translation aspects of R&D and the building of local enterprises. EDB is the lead government agency for planning and positioning Singapore as a global business centre and in creating value for investors and companies in Singapore. The Institutes of Higher Learning under the Ministry of Education and the hospitals and medical centres under the Ministry of Health engage in basic to applied research as well as bring innovations out of the academic and medical institutions.



Singapore's Innovation System³⁹

³⁹ <http://www.nrf.gov.sg/research/r-d-ecosystem/r-d-framework>

Canada

	Canada	Alberta
Population	33.2 million ⁽¹⁾	4.0 million ⁽¹⁾
Population density³	3.5/km ² ⁽¹⁾	5.7/km ² ⁽¹⁾
Major export sectors	Motor vehicles and parts, industrial machinery, aircraft, telecommunications equipment; chemicals, plastics, fertilizers; wood pulp, timber, crude petroleum, natural gas, electricity, aluminum	Mining, energy, petroleum products and petrochemicals and plastic, food and agriculture, wood, machinery
R&D intensity (GERD/GDP)	1.9% ⁽²⁾	1.2% ⁽³⁾
Share of private sector R&D	47% ⁽²⁾	51% ⁽³⁾
Triadic patents per million people per year	14.4 ⁽²⁾	10.3 ⁽⁴⁾

⁽¹⁾ 2013 data

⁽²⁾ 2011 data or latest available year (OECD data)

⁽³⁾ 2009 data

⁽⁴⁾ 2007 data

Canada is a federation, with a central government, 10 provinces, and 3 territories. The provinces and territories have jurisdiction over natural resources, health, and education; the federal government has responsibility for transportation, national security, foreign affairs, and telecommunications. The federal government is also responsible for setting and implementing research policy at the national level. The provinces and territories focus on implementing research policies and delivering research programs customized to their specific needs. Provinces also are responsible for universities, colleges, and hospitals within their jurisdictions and provide the majority of the basic physical infrastructure and operating costs.

Federal research policy has moved to emphasize the application of R&D to complement existing policies linked to the creation of knowledge. The policy document *Advantage Canada*, written in late 2006, placed an even greater priority on the application of R&D to support the achievement of social and economic objectives. This policy remains Canada's science and technology strategy.

In 2012, the private sector funded almost half of all research in Canada (47%), with the federal government (19%) and higher education (18%) the next largest funders. In 2012, the business sector was also the largest performer of research at 52%, with the higher education sector second at 38%.

Canada's R&D intensity (GERD/R&D) rose to a high of 2.07% in 2004, but by 2008 the ratio had declined to 1.85%. It increased slightly to 1.92% in 2009 but has since declined further. The value of 1.74% in 2011 was the lowest in more than 10 years.

Canadian research policy is still based on the 2007 research policy document *Mobilizing Science and Technology to Canada's Advantage*, which is linked to the 2006 economic plan. The research policy objectives are aligned with the

Appendix 5 – Canada

three major policy goals identified in the economic plan. These are (1) creation of an Entrepreneurial Advantage, (2) a Knowledge Advantage, and (3) a People Advantage. The government policy includes a challenge to the private sector to undertake more R&D to improve Canada's competitive position and promote economic growth. While there have been annual updates, the policy documents *Advantage Canada* and *Mobilizing Science and Technology to Canada's Advantage* continue to provide the broad economic and research policy guidance that underlies more specific policies and programs. Annual budget allocations and programs since 2006 also reflect these broad policies.

In 2011, the federal government undertook a major policy review to examine the effectiveness of current policies and expenditures. The resulting Review of Federal Support to R&D, known as the Jenkins Report,⁴⁰ focused on putting delivery of business innovation programming under one origination, adjusting federal tax credits for small- and medium-size businesses, and refocusing the National Research Council. The aim of the report was to improve Canada's poor performance in supporting business innovation. Since the release of the Jenkins Report, the National Research Council has been redirected towards business support and federal tax policies are being examined.

Industry Canada is the Canadian government department with primary responsibility for developing research and innovation policy. Other science-based departments and agencies (SBDAs) develop department/agency-level research policies specific to their mandate and objectives based on the high-level policies in *Mobilizing Science and Technology to Canada's Advantage*. These SBDAs share responsibility with Industry Canada for development and delivery of science policies and programs.

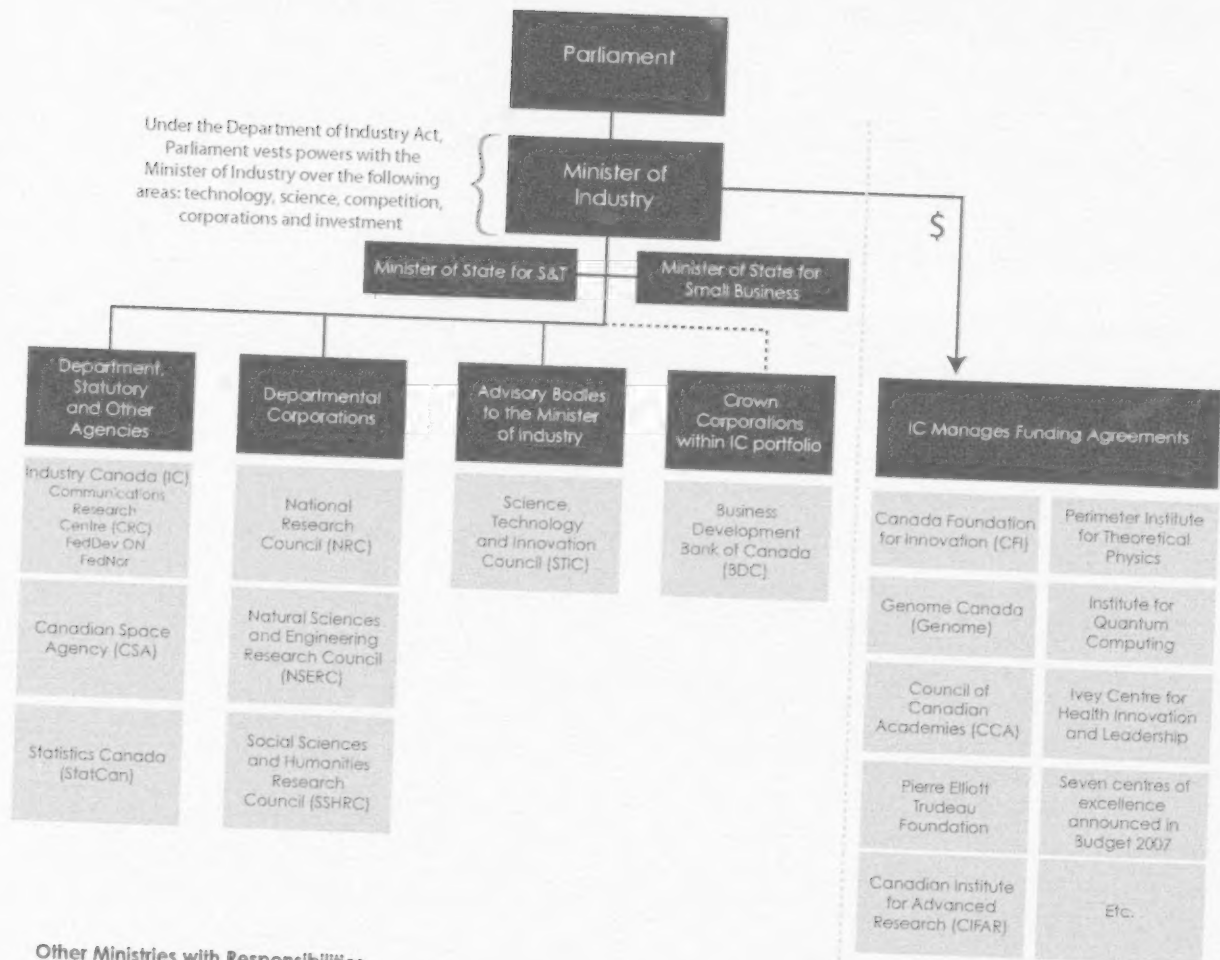
The Science Technology and Innovation Council is made up of senior business and academic representatives who provide the government with independent advice on major policy matters. In 2008, 2010, and 2012, the Council produced a summary of Canada's innovation performance, identifying strengths and weaknesses.

The Prime Minister and Cabinet have the highest level of responsibility for the Canadian federal research system. The Minister of Industry is responsible for overall research policy, but actual political responsibility is shared in practice among a number of ministers. All ministers are responsible for interpreting the overall research policy in the context of their departmental mandate. There is a Committee of Science Associate Deputy Ministers from the SBDAs who share information. Coordination among departments occurs on a case-by-case basis.

Several federal organizations have a mandate to fund research, performed mainly at universities. These include departments such as the Natural Science and Engineering Research Council and the Social Sciences and Humanities Research Council, and agencies such as the Canada Foundation for Innovation. Most other SBDAs both carry out intramural research and fund extramural research at universities and other research organizations, with most varying between the two. Some SBDAs and agencies, such as Sustainable Development Technology Canada, co-fund R&D projects with industry that are at the advanced development or pilot stage and are strong candidates for commercial application. Research is carried out in business enterprises, universities, government laboratories, and a range of public, not-for-profit, and private research institutes. Most research institutes receive funding from both government and business.

⁴⁰ Independent Panel on Federal Support to Research and Development (R&D), *Innovation Canada: A Call to Action*, 2011.

Appendix 5 – Canada



Other Ministries with Responsibilities

Agriculture and Agri-Food Portfolio

- Agriculture and Agri-food Canada
- Canadian Food Inspection Agency

Canadian Heritage Portfolio

- Canadian S&T Museum Corporation
- Library and Archives Canada
- Canadian Museum of Nature
- Canadian Museum of Civilization

Environment Portfolio

- Environment Canada
- Parks Canada

Fisheries and Oceans Canada

- Canadian Coast Guard

Health Portfolio

- Health Canada
- Public Health Agency of Canada
- Canadian Institutes of Health Research

National Defence Portfolio

- Department of National Defence
- Defence R&D Canada

Natural Resources Portfolio

- Natural Resources Canada
- Atomic Energy of Canada Limited

Public Safety Portfolio

- Royal Canadian Mounted Police
- Canadian Border Services Agency

Department of Finance Canada

Foreign Affairs and International Trade Canada

Human Resources and Skills Development Canada

Public Works and Government Services Canada

Regional Development Agencies

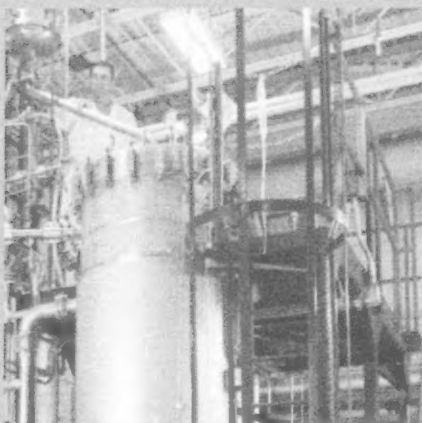
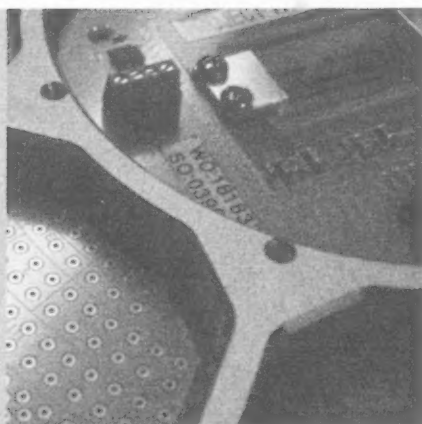
Transport, Infrastructure and Communities Portfolio

Canada's Innovation System⁴¹

⁴¹ SOURCE: Jenkins Report, *op. cit.*







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